2000 ONONDAGA LAKE AND TRIBUTARIES MACROINVERTEBRATE MONITORING

PREPARED FOR:

ONONDAGA COUNTY
DEPARTMENT OF DRAINAGE AND SANITATION
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Section 1. Introduction

1.1. Rationale for Study

Macroinvertebrate sampling is among the requirements of the Amended Consent Judgement signed in January 1998. Onondaga County is required to assess the macroinvertebrate communities of selected Onondaga Lake tributaries (Appendix D, III. 5 ".... Sample the stream's macroinvertebrate communities and calculate the New York State Department of Environmental Conservation (NYSDEC) rapid Field Biotic Index throughout the tributaries' length....") and the Lake (Appendix D, IV 4 "Complement the chemical monitoring program with a biological monitoring effort to assess the densities and species composition of phytoplankton, zooplankton, macrophytes, macrobenthos, and fish"). Sampling in the tributaries will be conducted every two years, and sampling in the lake's littoral zone will be conducted every five years through the 15 years of the County's Ambient Monitoring Program (AMP). The objectives of monitoring this element of the aquatic ecosystem are to:

- Characterize the existence and severity of use impairment, and

  Evaluate the effectiveness of control actions (improvements to wastewater collection and treatment, both at Metro and the CSOs).

Beginning in the year 2000, Onondaga County's AMP includes macroinvertebrate sampling. The 2000 program was designed to provide the baseline for documenting the response of the macroinvertebrate communities to improvements in wastewater collection and treatment systems. The design of the 2000 program was finalized following a 1999 investigation to determine sampling locations and the number of replicates.

1.2. Ecological and Regulatory Background

Macroinvertebrates are an important component of the aquatic food web. Freshwater macroinvertebrate taxa include aquatic insects (Insecta), worms (Oligochaeta), snails (Gastropoda), clams (Bivalvia), leeches (Hirudinea), and crustaceans (Crustacea). These organisms provide the link in the food web between microscopic organisms and fish, and also facilitate the transfer of energy and materials between the terrestrial and aquatic ecosystems.

There are important differences among groups of macroinvertebrates that influence the structure and function of a particular community. Difference in tolerance to environmental conditions is the basis for using these organisms as biological indicators of environmental quality. The biological community integrates the effects of different pollutant stressors and thus provides a holistic measure of their aggregate effect (Klemm et al. 1990). Benthic macroinvertebrates are good indicators of localized conditions. Because they have limited migration patterns or a sessile mode of life, they are well suited for assessing site-specific impacts of point and nonpoint discharges. Many state agencies, including NYSDEC, use macroinvertebrates as indicators of stream quality.

One important difference between groups of macroinvertebrates is their tolerance to organic (oxygen-demanding) wastes. Macroinvertebrates can be grouped into three broad categories based on their tolerance to organic waste: intolerant, moderately tolerant, and tolerant. The intolerant group includes species of mayflies, stoneflies, caddisflies, riffle beetles, and hellgrammites; the tolerant group includes worms, some midges, leeches, and some snails. The moderately tolerant group includes most snails, sowbugs, scuds, blackflies, craneflies, fingernail clams, dragonflies, and some midges (Welch 1980). What follows is a general description of the major groups of organisms that are of significance to this study.

Mayflies; Class Insecta, Order Ephemeroptera. The mayflies are a primitive insect found in a wide variety of running and standing water habitats. They are aquatic as larvae (nymphs) and briefly terrestrial as adults. Mayflies are unique in that an intermediate fully winged terrestrial life stage (the subimago) occurs between the aquatic nymph stage and the sexually mature winged adult stage (imago). Nymphs are primarily grazers and collectors feeding on a variety of detritus and algae, although some are also filter-feeders and predators. Mayflies typically reach peak abundances in cool clean headwater streams and are generally less abundant and diverse in lakes (Peckarsky et al.

1990). Many are highly susceptible to water pollution and habitat degradation, including low dissolved oxygen, chlorine, ammonia, metals, pesticides and acidity (Bode et al. 1993). For this reason mayflies have proven to be very useful for biomonitoring of water and habitat quality.

Stoneflies; Class Insecta, Order Plecoptera. The stoneflies are close relatives of cockroaches. These organisms have retained the primitive characteristic of possessing tails but have the advanced ability to fold their wings over their back (Peckarsky et al. 1990). Stoneflies are entirely aquatic as nymphs and most are terrestrial as adults. For the most part, stonefly nymphs are either predators (feeding on other invertebrates) or leaf detritivores (feeding on shredded leaves). Most species of stonefly are restricted to flowing waters of relatively high oxygen concentration and their presence is generally considered to be an indicator of good water quality. They are sensitive to many of the same pollutants as mayflies with the exception of acidity (Bode et al. 1993).

Caddisflies; Class Insecta, Order Trichoptera. Caddisflies are a highly advanced and common order that is closely related to the moths and butterflies (Order: *Lepidoptera*), but are adapted for aquatic life as larvae (McCafferty 1983). Many caddisflies build intricate shelters from sand, small stones, leaf fragments, sticks etc. The material and shapes of shelters are generally unique to each taxon. Caddisflies employ a variety of feeding strategies, from strict predation to the construction of intricate nets for filtering detritual particles from the water. Caddisflies are most commonly found in cool water streams, although some species are found in lakes and ponds. Many species are sensitive to pollution, although there are some that are tolerant of polluted conditions and one family is often found in the recovery zones of streams below sewage discharges (Bode et al. 1993). Although caddisflies have a wide range of tolerances, their presence generally indicates good water quality.

Water Beetles; Class Insecta, Order Coleoptera. Beetles as a whole constitute the largest and most highly advanced order of insects with over 30,000 species known in

North America (McCafferty 1983). Of these, over 1,000 are either aquatic or semi-aquatic (McCafferty 1983). Water beetles occur over a wide variety of aquatic and semi-aquatic habitats. They can be found in or on the substrate, in or on aquatic macrophytes, or swimming at or beneath the water's surface (McCafferty 1983). Almost all adults are dependent on atmospheric oxygen and must either carry an air bubble with them or have physical adaptations to acquire atmospheric oxygen. Riffle beetles and water pennies are the beetles most commonly found in streams; both usually require swift current and high dissolved oxygen concentrations. Presence of these two species is generally considered to indicate good water quality. There are also many other species of aquatic beetles that live in virtually all common freshwater habitats and have varying degrees of tolerance to pollution (McCafferty 1983).

Midges and Flies; Class Insecta, Order Diptera. The dipterans are one of the largest, most highly evolved, and most diverse groups of aquatic insects (Peckarsky et al. 1990). Some commonly known dipterans include mosquitoes, deerflies, craneflies, blackflies, and midges. Most dipterans spend much of their lives as aquatic larvae that hatch into terrestrial adults. The dipteran family *Chironomidae* is present in almost all freshwater systems and is of special importance not only because of its diversity but because of the ability of some species to tolerate extreme levels of pollution (McCafferty 1983). Some species contain hemoglobin that stores oxygen within the body thus allowing the organism to exist temporarily in habitats with little or no dissolved oxygen (Peckarsky et al. 1990). These species are typically bright red in color and are commonly referred to as "bloodworms". Bloodworms are highly tolerant of polluted conditions and organic enrichment; some are common in sewage oxidation ponds. In general, the presence of bloodworms or chironomids in large numbers is an indicator of poor water quality (Bode et al. 1993).

Aquatic Worms; Phylum Annelida, Class Oligochaeta. Aquatic worms resemble earthworms but are generally smaller, although some species can reach a length of up to three inches. Most aquatic worms live in silty substrates and among the debris and detritus of fresh waterbodies. They ingest large quantities of soft sediment and utilize the organic fraction for their nutrient and energy source (McCafferty 1983, Peckarsky et al. 1990). Many worms, especially tubificid worms, burrow headfirst into the soft sediments and build vertical tubes from which their posterior end protrudes and undulates in the current (McCafferty 1983). Some worms can tolerate severe levels of pollution and can often be found at high densities in organically polluted waterbodies and are therefore valuable pollution indicators.

Snails; Class Gastropoda. Snails are common in freshwater habitats throughout the northeastern United States (Peckarsky 1990). They are divided into two groups: the prosobranchs and pulmonates (Peckarsky 1990). Respiration in snails occurs by means of gills in the prosobranchs and by a type of lung in the pulmonates (Peckarsky 1990). All snails, to at least some extent, use cutaneous respiration through their body membranes (Ghiretti 1966). Because they respire through gills, the prosobranchs are usually intolerant of low concentrations of dissolved oxygen in their aquatic habitat. The pulmonates, on the other hand, can often tolerate extreme levels of pollution by rising to the surface and breathing air. Most feed on encrusted algae and organic material, but some are detritivores or omnivores (McCafferty 1983).

Sowbugs: Class Crustacea, Order Isopoda. Most sowbugs are either terrestrial or marine, with only about 5% occurring in freshwater (Peckarsky 1990). Sowbugs are primarily scavengers, feeding on dead animal and plant material (Peckarsky 1990). Many can tolerate high organic inputs and the resulting low concentrations of dissolved oxygen (Bode et al. 1993).

1.3 Description of Tributary Sampling Sites

This section gives a brief overview of tributary site descriptions. Figure 1 is the location map of the 2000 monitoring sites and Figure 2 is a detailed map of sampling sites within the City of Syracuse.

1.3.1 Onondaga Creek.

Onondaga Creek is the largest tributary to Onondaga Lake. The Onondaga Creek watershed encompasses approximately 298 km^2. The creek, which originates in the Tully Valley, flows north and enters Onondaga Lake through the Barge Canal at the southern end of the lake. Its length is approximately 44.2 km along the main stem. The lower one-third is located in the City of Syracuse. The creek currently receives urban stormwater runoff, discharge from combined sewer overflows (CSOs) in Syracuse, and sediment and brackish water from the Tully mud boils located about 33 km upstream from the creek's mouth. Four macroinvertebrate sampling sites are located on Onondaga Creek. Sites were selected to be upstream and downstream of potential sources of impact.

1.3.1.1. Onondaga Creek Site 1 – Tully Farms Road.

This site is located about 27 km upstream of Onondaga Lake, approximately 50 m downstream of where Tully Farms Road crosses the creek between Otisco Road and Oak Hill Rd. This site is well upstream of CSOs, about 3 km upstream of the mud boil area, and about 1 km upstream of a large dairy farm. The stream in this area is composed of alternating shallow riffle/pool habitats with mostly gravel substrate and naturally meanders through a combination of scrub shrubs and forest.

1.3.1.2. Onondaga Creek Site 2 – Webster Road.

This site is located about 21 km upstream of Onondaga Lake where Otisco Road crosses the creek just south of Rt. 20. This area is downstream of both mudboils and a large dairy farm but is still well upstream of CSO discharges. The stream in this area is swift and shallow with gravel and boulder substrate. The natural meander of this section seems to have been straightened in the past. There is limited riparian vegetation, mostly composed of shrubs and small trees, along the banks.

1.3.1.3. Onondaga Creek Site 3 - Dorwin Ave Bridge.

Located approximately 8.5 km upstream of Onondaga Lake and 50 m downstream of the Dorwin Ave Bridge, this section flows through a residential area of Syracuse and Nedrow. This site is still upstream of all CSOs, but receives urban runoff from the south end of the City of Syracuse and the Village of Nedrow. The creek in this area, and for a distance of approximately 2 km upstream, is channelized, with steep banks and little streambank vegetation or canopy cover. The sampling area is shallow and velocity is high, although there are nearby areas where the water is deep and slower moving. Bottom sediments are predominantly gravel and sand.

1.3.1.4 Onondaga Creek Site 4 – Spencer Street.

This site is the most downstream sampling point on Onondaga Creek, located less than 0.5 km from where Onondaga Creek enters the Barge Canal Terminal at the south end of Onondaga Lake, and about 200 m upstream of the Spencer Street bridge. This site is downstream of all but one CSO point. The immediate area surrounding this site is developed with several office buildings and parking lots near the stream. Footbridges cross the stream at several locations. Riparian vegetation is minimal, consisting mostly of shrubs growing on steep banks. The stream itself is wide and swift with mostly gravel, sand and boulder sediments. Some semblance of a meander is present, as opposed to areas immediately upstream that have been straightened and channelized, with concrete bottoms and banks that offer minimal cover.

1.3.2 Ley Creek

The Ley Creek watershed is approximately 77 km^2 and extends eastward from the southeastern end of Onondaga Lake. The creek flows mainly through residential and industrial areas except for the headwaters, which drain wetlands. Several closed landfills, dredge spoil disposal areas and numerous commercial and industrial sites exist within the drainage basin. Currently, two CSOs discharge to the creek near the Rt. 81 overpass. Three monitoring sites were located in Ley Creek in 2000.

1.3.2.1. Ley Creek Site 1 – Townline Road Bridge.

This site is located about 4.5 km from Onondaga Lake is about 20 m upstream of the Townline Road Bridge, and is upstream of all CSO discharges. The nearby area is a combination of wet meadow and deciduous wetland forest with extensive stands of *Phragmites* and a few deciduous trees and some nearby parking areas and roads.

The monitoring site is shallow with low water velocity. The stream bottom is almost entirely silt mixed with gravel and moderate to large beds of submerged aquatic vegetation, composed mostly of Eurasian watermilfoil (*Myriophyllum spicatum*) and curly pondweed (*Potamogeton crispus*).

1.3.2.2. Ley Creek Site 2 - 7th North Street.

This section, located approximately 1.5 km upstream of Onondaga Lake, about 20 m upstream of the 7th North Street bridge, and flows through a *Phragmites australis* dominated wetland. This site is also upstream of all CSOs. Beartrap Creek enters just downstream of the sample site. The stream in this area is straight and channelized, with sluggish flow and deep waters. The mud banks show strong evidence of erosion and are dominated by *Phragmites australis.* Sediments within the stream are almost entirely silt and sand. Areas upstream of this site (between sites 1 and 2) were undergoing remediation for PCB contamination at the time of sampling. Soil near the stream between Sites 1 and 2 was being removed and near shore vegetation had been bulldozed.

1.3.2.3. Ley Creek Site 3 – Park Street.

This sampling site was located about 0.5 km from the lake, is about 100 m downstream of the Park Street Bridge, and approximately 150 m downstream of the only two CSO discharges in Ley Creek. At this location, Ley Creek is deep and water velocity is low. The shoreline area immediately surrounding the stream is covered with low-lying shrubs and wet meadow vegetation (Acres and Beak 1999). The bottom composition is almost entirely sand and silt with a mixture of oncolites. No submerged vegetation was present. According to the rating of the USGS gauge, Ley Creek is affected by Onondaga Lake backwater in this low gradient stream segment.

1.3.3 Harbor Brook

Harbor Brook enters Onondaga Lake on the south shore approximately 1 km west of the Barge Canal. The creek's watershed is long and narrow, draining an area of approximately 29 km^2 with a main stem length of about 12.1 km. The lower reaches carry runoff from the City of Syracuse while the headwaters flow through a mixture of agricultural and residential lands. The approximately 2 km of stream that flow through the city are diverted through underground pipes. The creek currently receives urban runoff and discharges from 19 CSOs. Three monitoring locations were selected along Harbor Brook.

1.3.3.1. Harbor Brook Site 1 - Velasko Road.

The most upstream site on Harbor Brook is located behind the Western Lights Shopping Plaza about 3 km from Onondaga Lake and about 10 m downstream of the Velasko Road bridge. The site is upstream of CSOs and the underground section, and is in an urban setting. At this site, Harbor Brook is a shallow stream that flows from a wetland on the upstream side of Velasko Road. Vegetation is common within the stream and consists mainly of emergent species. Several riffles are present but most of the stream is composed of shallow pools. The riparian corridor is mown grass with limited riparian vegetation. The stream bottom is composed of combinations of rubble, gravel, sand and silt with varying amounts of submerged aquatic vegetation.

1.3.3.2. Harbor Brook Site 2 - Hiawatha Boulevard.

This site is downstream of all CSO discharge points and the urban stream segment that flows through buried pipes. It is located at a USGS gauging station about 0.5 km from the lake and about 100 m downstream of Hiawatha Blvd.. An automobile dealership and garage is located immediately upstream of this site. In this urban location the stream flows through old calcium carbonate wastebed material; the stream is shallow and water velocity is generally low. A single riffle was present for sampling. The stream is channelized in this reach; the bottom is composed of boulders, silt, tires and other debris overlying solid concrete. There is a large amount of submerged aquatic vegetation consisting mostly of curly pondweed. The bank is concrete and steep. Low growing vegetation that offers little canopy cover is present above the concrete banks.

1.3.3.3. Harbor Brook Site 3– Rt. 690.

This most downstream site is located about 200 m downstream of Interstate Rt. 690 and is only about 100 m from Onondaga Lake. This site is downstream of all CSO discharge points. At this location, Harbor Brook flows through and receives direct runoff from calcium carbonate wastebed material. *Phragmites* and wetland shrubs dominate the streambanks. The stream bottom is composed of mostly silt with no aquatic vegetation. A strong petroleum odor was evident near this site.

1.4 Description of Lake Sampling Sites

Onondaga Lake is located on the northern border of the City of Syracuse in Onondaga County, New York, USA (43° 06' 54" N, 76°14'34" W). The lake has a surface area of 11.7 km^2, a volume of 131 x 10^6 m^3, a mean depth of 10.9 m and a maximum depth of 19.5 m. It is 7.6 km long and has a maximum width of 2 km (Effler (ed.) 1996). The lake's drainage basin is approximately 642 km^2 and lies almost entirely within Onondaga County. The drainage basin is divided into six distinct subbasins: Nine Mile Creek, Onondaga Creek, Ley Creek, Bloody Brook, Harbor Brook, and Sawmill Creek. The Metropolitan Syracuse Sewage Treatment Plant (Metro) discharges treated wastewater to the south end of the lake. Most of the water that flows into Onondaga Lake through Metro originates outside of the basin. The Lake flows into the Seneca River via the outlet at the north end. The Seneca River joins the Oneida River to form the Oswego River, which then flows into southeastern Lake Ontario at the City of Oswego, New York, approximately 65 km north of Syracuse.

Five sampling locations were selected in the lake's littoral zone to complete the 2000 monitoring effort. The site locations are the same as those used in 1999. Sampling at each location was conducted at a depth of approximately 1.5 m. These sites were selected to reflect major sediment characteristics and proximity to point source discharges (Figure 3). The new site numbers for 2000 are as follows:

2000 Sites
Site 1 Metro
Site 2 Wastebeds
Site 3 Maple Bay
Site 4 Hiawatha Point
Site 5 Ley Creek

1.4.1 Lake Site 1 – Metro

This site is located just west of the Metro discharge at the south end of the lake (45° 03' 944"N, 76° 11' 000" W). This section of the lake receives high wave energy because of the large fetch from the predominant north/northwest winds. Historically, high sediment loads from the Tully mud boils entering through Onondaga Creek have deposited in this area. Remedial efforts in the early mid-1990's have resulted in a decrease in sediment loading to Onondaga Creek and, therefore, to the lake (USGS 1999). This area of the lake is shallow and bottom sediments are composed mostly of fine sand and silt sediments. An oily sheen and odor were noted in some of the sediment samples. Large beds of aquatic vegetation are present and consist mostly of sago pondweed (*Potamogeton pectinatus*) and water stargrass (*Zosterella dubia*).

Lake Site 2 –Wastebeds

This site is located along the wastebeds on the southwestern shore near Interstate 690 (45° 05' 084"N, 76° 12' 822" W). A calcium carbonate ($CaCO_3$) crust in nearshore areas and clay, sand and silt in slightly deeper water characterize littoral sediments. Some of the clays were observed to be robin's egg blue in color. Mats of filamentous algae were present on the sediment surface. Little aquatic vegetation was observed near the sampling location.

Lake Site 3 – Maple Bay

Maple Bay is located in the northwest corner of the lake (43° 06' 427"N, 76° 14' 580" W) and has been the focus of experimental habitat improvement projects designed to enhance the growth of aquatic macrophytes. This area is characterized by generally soft silty sediment and extensive macrophyte growth. The area is largely protected from predominant north/northwest wind and is typically the calmest area of the lake. Extensive beds of aquatic vegetation are present from near shore to a depth of approximately 4 m. Sago pondweed, water stargrass and elodea (*Elodea canadensis*) are most abundant but lesser amounts of three other species can also be found here: Eurasian watermilfoil, coontail (*Ceratophyllum demersum*), and curly pondweed.

1.4.4 Lake Site 4 – Hiawatha Point

This site is located on the east shore in Onondaga Lake Park at Hiawatha Point (43° 06' 249"N, 76° 13' 226" W). This area receives a moderate amount of wave energy (EcoLogic, 1999). The substrate consists of a combination of ovoid calcium carbonate concretions called oncolites and sand mixed with old shell fragments. Beds of aquatic vegetation are present from shore to a depth of about 4 m. Filamentous algae were attached to the sediment surface at many places in this area of the lake.

1.4.5 Lake Site 5 – Ley Creek

This site is north of Ley Creek along the southeastern shoreline of Onondaga Lake (43° 04' 669"N, 76° 10 897" W). Sediments are predominantly oncolites and sand because of the long fetch and resultant high wave energy affecting the area. Little vegetation is present in this area of the lake except at the edge of the littoral zone where beds of water stargrass are present. The littoral zone is generally flat with little complex structure or features.

Section 2. Methods

2.1 Protocols and Training

The protocols for data collection, analysis, and interpretation used for this study are consistent with the New York State Department of Environmental Conservation Program Plan for Rotating Intensive Basin Surveys (RIBS), Water Quality Section. Specifically, the methodology was consistent with the 1996 Appendix B, Macroinvertebrate Monitoring Workplan - Quality Assurance Work Plan for Biological Stream Monitoring in New York State.

Dr. Deedee Kathman of the Aquatic Resources Center in College Grove Tennessee conducted a two day training program with county personnel in June of 2000. Field sampling protocols with petite ponars, kick samples and multiplates were covered in the first half of day one. Laboratory subsorting techniques and invertebrate identification were covered in the last half of day one and all of day two.

2.2 Methods

2.2.1. Tributaries

A total of 10 sites were sampled in the tributary system of Onondaga Lake; four (4) sites in Onondaga Creek, three (3) sites in Ley Creek; and three (3) sites in Harbor Brook (refer to Figures 1 & 2). D-frame kick nets were used as the primary sampling gear at each site. Kick sampling was carried out in Onondaga Creek and two of the three sites in Harbor Brook. Jab samples were used in Ley Creek and one site in Harbor Brook.

Following is a summary of sample locations:

Waterbody	Site Designation	Description
Onondaga Creek	OCS1	Tully Farms Road
	OCS2	Webster Road
	OCS3	Dorwin Avenue
	OCS4	Spencer Street
Ley Creek	LCS1	Townline Road
	LCS2	7th North Street
	LCS3	Park Street
Harbor Brook	HBS1	Velasko Road
	HBS2	Hiawatha Boulevard
	HBS3	Rt. 690

Sampling was conducted between July 17 and July 19, 2000. The field crew composed of Onondaga County Department of Drainage and Sanitation (OCDDS) technicians. An environmental scientist from EcoLogic was present during the first day's sampling for QA/QC purposes.

At each location the following water quality parameters were recorded: water temperature (°C), conductivity (µS), pH, and dissolved oxygen (mg/L). Substrate type was determined by visually estimating the percentage of clay, silt, sand, gravel, cobble and boulder in the sample. Tributary width and estimated high water mark were measured. The percentage of overhead vegetative cover and the presence of any submerged aquatic vegetation were recorded.

Kick sampling was conducted at tributary sites where riffle areas were present. Kick sampling was conducted at all four Onondaga Creek sites (OCS1, OCS2, OCS3 and OCS4), two Harbor Brook sites (HBS1 and HBS2). Four replicates were collected at each of these locations. No sites in Ley Creek were kick sampled because of a lack of appropriate habitat. Am alternate method of sampling developed by NYSDEC was jab samples that were collected at all three Ley Creek sites (LCS1, LCS2, and LCS3) and one Harbor Brook site (HBS3). Four replicates were also taken at each jab sample site.

Kick sampling was conducted in riffle areas with substrate predominately composed of cobble, gravel and/or sand, a water depth of less than 0.5m and a mean water column velocity of greater than 0.4m/sec. A standard 9 in x 18 in D-net with 0.8 mm mesh was used. At each station, sampling progressed diagonally 5 m across the stream for 5 minutes. The sample was taken by positioning the D-net on the bottom about 0.5 m downstream of the person sampling. The sampler used his/her feet to disturb the bottom so the streambed material, including macroinvertebrates, was carried into the net. The material from the net was removed and placed into a U.S. No. 30 mesh wash bucket and gently rinsed with water to remove fine materials. The remaining contents were placed into labeled wide-mouth glass sample jars, preserved with 10% formalin, and stored for transport to the processing laboratory.

Jab samples were collected from the mid section of slow, soft-bottomed sections of Ley Creek. A D-net with the same dimensions as in kick sampling was used. The net was jabbed into the soft bottom sediments and raked across the bottom until the net was filled with sediment. The net was brought to the surface and rinsed to remove fine materials. The remaining contents were placed into labeled wide-mouth glass sample jars, preserved with 10% formalin, and stored for transport to the processing laboratory.

2.2.2.

Macroinvertebrate sampling was conducted at five locations in Onondaga Lake between June 7 and 12, 2000. The five locations were: 1) Metro outfall; 2) the wastebeds; 3) Maple Bay; 4) Hiawatha Point; and 5) north of Ley Creek (refer to Figure 3). The field crew was composed of OCDDS technicians and engineers. An environmental scientist from EcoLogic was present during the first two days of sampling for QA/QC purposes.

A total of 36 replicates per site were collected. Two boats were used; one to collect the samples and another to wash the collected material in a washtub. The same two technicians conducted all the Ponar deployments to minimize any sampling bias. The rope attached to the Petite Ponar dredge was calibrated in order to determine the depth that each sample replicate was collected. The dredge was set, lowered into the water, and allowed to freefall for the last 0.5 m to the bottom. The impact with the bottom activated the closing mechanism. The dredge was then slowly brought to the surface and the sample was placed into a labeled stainless steel pail. The samples were retaken if the dredge was only partially filled with sediment. Possible causes of less than a full sample include non-vertical deployment, premature triggering of the closing mechanism or an object stuck in the jaws of the ponar. If the sampling team observed material draining from the dredge, the sample was retaken. To the extent possible, comparable substrate was collected at each depth along the transect. The pails containing the samples were transferred to the wash boat for in-field processing.

Next, the contents of a discrete sample replicate were placed into a U.S. Standard No. 30 mesh (0.590 mm opening) Nalgene™ sieve inside a washtub overhanging on the side of the boat. The sample was gently washed with lake water using a small impeller pump to remove small particles (clays and silts). The contents remaining in the sieve were transferred to labeled wide mouth glass sample jars of various sizes depending on amount of material. A 10% solution of formalin was added before storing the sample.

On June 12, 2000, an array of five multiplate samplers was deployed at Site 2, on the wastebeds in Onondaga Lake, in about 1.5 m of water. Hester-Dendy type samplers were used as the multiplate samplers. Each sampler was composed of 15 - 3" x 3" hardboard plates mounted on a turnbuckle. Single, double and triple 1/8" hardboard spacers were used to separate the plates in a standardized manner. The samplers were suspended 1 meter below the surface. The apparatus was anchored by a 4" x 8" x 16" masonry block.

Multiplates were retrieved on July 14, 2000. The samplers were carefully retrieved, disconnected from the anchorage system, placed into separate plastic tubs filled with 10% formalin and transferred to the lab. At the lab each multiplate sampling device was taken apart with pliers. Accumulated organisms and debris were loosened from the plates with a drywall seamer and rinsed from the plates using water. The scraped material was then placed into a U.S. No. 30 sieve and gently rinsed with water to remove fine materials. The remaining contents were placed into labeled wide-mouth glass sample jars, preserved with 75% ethyl alcohol, and stored for later subsampling.

At each sampling location the following water quality parameters were collected at 0.5 m below the surface: water temperature (°C), conductivity (µS), dissolved oxygen (mg/L), and pH. A Hydrolab meter was used to collect the water quality data. At each location, the field team collected one composite sample of the sediments for laboratory texture analysis. A representative Petite Ponar grab sample was thoroughly mixed and placed into a large wide-mouth glass jar. The unpreserved sample was placed on ice until transfer to the analytical laboratory.

2.3 Laboratory Methods (Sorting)

Prior to sorting, all samples that had initially been fixed with formalin were rinsed through a U.S. no. 60 sieve with water, transferred back to their original sample bottle and preserved with 75% ethyl alcohol that had Rose Bengal stain added.

2.3.1. Tributary Kick Samples

Samples were washed through a U.S. no. 60 sieve with tap water to remove any remaining fine sediments and excess stained alcohol, and then emptied into a shallow pan. A small amount of tap water was added. The material was distributed evenly in the pan and the contents examined under magnification. Invertebrates were removed from the debris as they were encountered. Organisms were sorted into major groups, placed in labeled vials containing 75% ethyl alcohol, and counted. Sorting continued until 100 organisms had been removed.

2.3.2. Lake Petite Ponar and Multiplate Samples

Samples were washed through a U.S. no. 40 sieve with tap water to remove any remaining fine sediments and excessive Rose Bengal stain. The remaining material was then transferred to a metal pan with a small amount of water and distributed evenly. A Plexiglas divider was placed in the tray to divide the tray into quarters. A single quarter was selected randomly and sorted under magnification in its entirety. Invertebrates were removed from the debris as they were encountered. Organisms were sorted into major groups, placed in labeled vials containing 75% ethyl alcohol, and counted. Quarter subsamples were sorted in their entirety until 250 individuals had been removed. If large numbers of organisms were encountered, quarter subsamples were further divided into one-eighth samples and sorted in their entirety until a total of 250 organisms were removed.

2.4 Identification

All organisms were sent to the Aquatic Resources Center (ARC) of College Grove, Tennessee, for identification except for chironomids collected in the lake, which were sent to Dr. Leonard Ferrington at the University of Minnesota. All organisms were identified to the lowest possible taxonomic level. Generally, chironomids and oligochaetes needed to be cleared, slide-mounted and viewed through a compound microscope for proper identification. Most other organisms could be identified using a dissecting stereomicroscope. The number of individuals of each species from each sample were recorded on laboratory data sheets and entered into an Excel spreadsheet. Identified organisms were returned to Onondaga County for an archived reference collection. Both laboratories retained a few individual slide-mounted organisms for teaching purposes. All slides retained by the labs were documented.

2.5 Analysis

Biological monitoring programs using benthic macroinvertebrates to assess water quality often rely on several different indices of community composition to evaluate the ecological status of the sampled community (Novak and Bode 1992). Each index should contribute different information to the assessment to avoid redundancy and conflicting results. The Onondaga County macroinvertebrate monitoring program uses NYSDEC's Biological Assessment Profiles as the primary measure of the macroinvertebrate community for both lake Petite Ponar and its tributaries' kick samples. The Biological Assessment Profiles used for the lake Petite Ponar samples and tributary kick/jab samples are distinct from one another as the Petite Ponar criteria were developed for use in "soft sediments in rivers and lakes", the kick sample criteria were developed separately for use in "riffles with a substrate of rock, rubble, gravel or sand" and jab sample criteria were developed for use in "slow, sandy streams". Results obtained using multiplate sampling devices in the lake are not evaluated using NYSDEC's Biological Assessment Profiles as the NYSDEC multiplate criteria were developed for use in the main current of "pools or runs" of streams and not in lakes. Results for multiplates are compared independently using the metrics of: richness, diversity, non-chironomid and oligochaete richness, and Hilsenhoff Biotic Index.

2.5.1 NYSDEC Biological Assessment Profile

Sites are compared using NYSDEC Biological Assessment Profiles. For both tributary and lake petite ponar samples, an overall assessment of water quality for each site is calculated by averaging results of four (kick and jab samples) or five (Ponar samples) individual metrics obtained through a scaled ranking of the index values. The index values are converted to a common scale of water quality ranging from 0-10, with 0 being severely impacted and 10 being non-impacted. After all index values for a site are erted to scal al they eraged to btain ting eral water uality.

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2.5.1.3. Diversity

The Shannon-Weiner diversity index (Shannon and Weaver 1949, Weiner 1948) as modified by Weber (1973) was selected to quantify diversity. Diversity is a function of both the number of species present (richness) and the equitability of distribution of individuals within these species (evenness) (Washington 1984). A high diversity can be interpreted as indicating relatively undisturbed systems, complexity (MacArthur 1955), maturity, and functional stability (Karr 1968, Margalef 1968, Odum 1969). However, diversity may increase with disturbance of a system and thus, is not always associated with system stability (Washington 1984). Anthropogenic activities, such as high organic inputs, typically influence the measure of diversity (Brown 1978, Horn 1988). Diversity is greatest when high numbers of taxa are represented in equal proportions. Diversity can help determine if disparity occurs between different sites within the same waterbody. However, it is limited by the same deficiencies as species richness (i.e., much information is lost in the calculation). For example, a site that contains a diverse assemblage of tolerant organisms would likely not be considered "better" than a site with a less diverse assemblage of sensitive organisms. For this reason diversity is usually utilized with other more descriptive indices that, taken together, can yield a more thorough view of the community.

2.5.1.4. Dominance-3

Dominance-3 is the percent contribution of the three most abundant species (or taxa) in a sample. Typically a high dominance-3 value indicates unbalanced communities dominated by few species, although which species are dominating continues to be an important question.

2.5.1.5. Hilsenhoff Biotic Index (HBI)

HBI is considered by many investigators to be the most reliable index of composition of the macroinvertebrate community and water quality status (Novak and Bode 1992). HBI indicates the effects of organic pollution and is based on species-specific tolerance levels. Taxa are assigned tolerance values ranging from zero to ten, where zero and ten represent the extremes for intolerance and tolerance respectively (Hilsenhoff 1987). HBI not only includes the numbers of species and the distribution of individuals among species, but weighs abundance of each species according to its known ability to tolerate adverse water quality conditions, particularly organic inputs. High HBI values are associated with adverse impacts of organic pollution. Low HBI values indicate that the macroinvertebrate community is not impacted by organic pollution.

2.5.1.6. Percent Model Affinity

Percent Model Affinity (PMA) is a measure of similarity to a theoretically ideal non-impacted New York macroinvertebrate community, based on abundance of seven select taxonomic groups (Novak and Bode, 1992). The model kick sample community is composed of 40% Ephemeroptera, 5% Plecoptera, 10% Trichoptera, 10% Coleoptera, 20% Chironomidae, 5% Oligochaeta, and 10% other. For Ponar samples in flowing waters the ideal community is 20% Oligochaeta, 15% Mollusca, 15% Crustacea, 20% Non-Chironomidae Insecta, 20% Chironomidae, and 10% other. A high degree of similarity to the model indicates a community that closely approximates a theoretically ideal macroinvertebrate community.

2.5.1.7. NCO (Non Chironomid and Oligochaete) Richness

NCO richness is the number of species not belonging to the groups Chironomidae or Oligochaeta. Chironomids and oligochaetes are generally found in greater proportions at disturbed sites. The presence of NCO taxa in high numbers would be expected in higher water quality areas.

2.5.2. HBI Score

This index is used as part of NYSDECs water quality impact determination. The rationale and methodology for calculating HBI is discussed in section 2.5.1.5. Because this index directly tests for the impacts of organic enrichment, we have also chosen to look at this index independently. A raw HBI is ranked on a scale from 0 to 10 with zero being best and ten being worst. NYSDEC converts these HBI values into their water quality scale of 0 to 10 with zero being worse and ten being best. In order to avoid confusion we present the separate HBI values as the NYSDEC score for HBI and not the raw HBI calculation.

2.5.3. Percent Oligochaetes

The percent contribution of oligochaetes will also be used as an index of change over time. Oligochaetes can often thrive in areas where other invertebrates may not because of factors such as competition, soft substrate, organic enrichment, or low oxygen conditions. Some oligochaetes are found at the extremes of environmental conditions. For example, *Tubifex tubifex* may be found in very unproductive cold pristine headwater streams and near extremely productive, warm sewage discharges (Dr. Deedee Kathman, personal communication). Since few organisms are suited for the extreme conditions found in these two very different settings, *T. tubifex* can thrive by taking advantage of the lack of competition. It is quite unlikely that any of the sites in this monitoring effort would ever approach what would be considered an unproductive state. As oligochaetes are often found in high relative proportions in areas impaired by organic enrichment, their percent contribution to the community can be a good measure of the relative amount of organic enrichment at different locations. More importantly, the change in the percent contribution of oligochaetes over time, as well as the species composition, will be a good measure of the change in organic enrichment at the study sites.

2.5.4. NYSDEC Impact Source Determination

The NYSDEC Impact Source Determination (ISD) ascertains the primary factor influencing the macroinvertebrate community in stream riffle habitats based on similarity to impacted community models (Bode et al. 1996). The methods used for constructing these models can be found in Bode, et al. 1996. The community types used for impact source determination are as follows: Natural, Nutrient Additions-Nonpoint Sources, Toxic, Sewage Effluent/Animal Waste, Municipal/Industrial, Siltation, and Impoundment. The model community that exhibits the highest similarity to the test data indicates the likely impact source type for that site. If data from a site do not match any of the modeled communities (based on a standard of 50% affinity) the determination is "inconclusive'

Section 3. Results

3.1. Water Quality Results

3.1.1. Tributary Water Quality

Temperature, dissolved oxygen, specific conductance, and pH were measured at each site at the time of sampling. Table 1 summarizes water quality conditions measured in the tributaries.

3.1.1.1. Temperature

All tributaries were seasonally warm, with temperatures in the mid-teens to lower 20's °C range. Water temperature differences between sites in all sample tributaries are probably due to natural diurnal fluctuations and the tendency of streams to gradually warm as they proceed downstream. The observed temperatures are within the range for supporting a wide variety of macroinvertebrate life. However, some of the least tolerant species of stoneflies and mayflies may become stressed at the higher temperatures.

3.1.1.2. Dissolved Oxygen (DO)

Dissolved oxygen varied slightly between streams. Measured concentrations were within acceptable ranges for supporting a wide range of aquatic organisms. The low dissolved oxygen concentrations measured in 1999 in Ley Creek and parts of Harbor Brook were not observed again in 2000 (EcoLogic, 2000) when streamflow was consistently higher during the study period. However, concentrations of DO in all of Ley Creek and at Site 3 (Rt. 690) in Harbor Brook were noticeably lower than other stream sites.

3.1.1.3. Specific Conductance

Specific conductance, although variable, was generally elevated in comparison with typical freshwater streams. The lowest level of specific conductance was measured at Site 3 (Tully Farms Rd.) in Onondaga Creek (488 µS). The high values recorded at

Sites 2-4 in Onondaga Creek are likely influenced by discharges of artesian-pressured fresh and brackish water from mudboil areas immediately upstream of Site 2 (Webster Rd.). The high measurements of specific conductance at Site 4 (Spencer Street) may be further influenced by brackish water springs entering Onondaga Creek in its lower reaches. The specific conductance in Ley Creek (934-1079 μS) and Harbor Brook (2160–2370 μS) likely reflect groundwater chemistry since sampling was conducted in July when surface runoff is low. Macroinvertebrate species intolerant of high ionic levels could be adversely impacted by the high concentrations of dissolved salts.

3.1.1.4. pH

pH varied little between tributaries and sites, ranging from 7.7 to 8.5 across all sites. This alkaline pH reflects the underlying geology of the basin. Waterbodies with pH in this range are capable of supporting a wide range of aquatic life with no deleterious effects.

3.1.2. Lake Water Quality

Temperature, dissolved oxygen, specific conductance, and pH were measured in June at each site during Petite Ponar sampling. Lake water quality data are summarized in Table 2.

3.1.2.1. Temperature

Lake littoral zone water temperatures were seasonally warm ranging from 15 to 20° C across the five sites. These temperatures are expected for the littoral zone of lakes in this region during June. Temperature differences between sites are probably due to natural diurnal fluctuations and would likely not impact macroinvertebrate populations or community structure.

3.1.2.2. Dissolved Oxygen

Dissolved oxygen ranged from 9 to 12 mg/L across sites. These concentrations of DO are adequate for supporting a wide range of aquatic life in the littoral zone.

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3.2.1.1 Onondaga Creek

Sediment characteristics in Onondaga Creek were generally consistent between sites. All sites had varying proportions of gravel, cobble and boulders. At Site 3 (Dorwin Ave.) an increased amount of silt was mixed with the cobble and boulders as compared to other sites.

3.2.1.2. Ley Creek

Sediments within Ley Creek varied slightly between sites but were primarily composed of silt. Site 3was silt mixed with gravel. Site 2 was entirely composed of silt from which a petroleum odor emanated. Site 3 contained a combination of silt mixed with what appeared to be large oncolites.

3.2.1.3 Harbor Brook

Sediments in Harbor Brook differed greatly between the three sites. Sediment composition at Site 3 was predominantly gravel with finer grained sediments mixed in. Site 2 was composed of silt-covered concrete with numerous discarded tires and other debris. Sediments at Site 3 were mostly wastebed material ($CaCo_3$) mixed with silt and some gravel.

3.2.2. Lake Sediments

Figure 4 summarizes the texture analyses of the littoral zone sediment samples collected at macroinvertebrate sampling locations during 2000. Sediments were characterized as being either silt/clay (<0.074 mm), fine sand (0.07 to 0.25 mm), medium sand (0.25 to 0.59 mm), coarse sand (0.59 to 2.0 mm), fine gravel (2.0 to 9.52 mm) or medium gravel (9.52 to 25.4 mm). Sites 1 and 3-5 were generally similar with fine and medium grained sands comprising the majority of the sediment. The sediment at Site 2 was different from the other sites; texture was mostly silt/clay-sized particles that are probably composed largely of wastebed material. Since this site is located on the wastebeds it is not surprising that the sediments appear different from other areas of the lake.

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3.2.2.5. Site 5 – Ley Creek

Coarse (15%), medium (23%) and fine (31%) grained sands made up the majority of the sediment at Site 5. Past studies have documented the occurrence of oncolites along the entire southeastern shoreline of the lake where Site 5 is located (Madsen et al. 1996; Dean and Eggleston, 1984). Gravel-sized particles, predominantly oncolites, contributed 26% of the sediments at this site.

3.3. Macroinvertebrate Results

3.3.1. Tributaries

3.3.1.1. Onondaga Creek

Conditions at Sites 1–3 upstream of the City of Syracuse ranged from no impact to slightly impacted, based on NYSDEC water quality impact assessment scores (range 6.2 –7.6) (Table 3, Figure 5). The differences between Sites 1-3 were not statistically significant, however. The most downstream site on Onondaga Creek, Site 4 at Spencer Street, is downstream of all but one CSO and vast areas of dredged, straightened and concreted stream. This site was borderline moderately/severely impacted, based on NYSDEC assessment scores, and was significantly different from Sites 1- 3.

HBI scores indicate a general trend towards greater impact from organic pollution as the stream moves downstream. The drop in HBI score between Site 4 and the other sites does not account for the overall drop in NYSDEC assessment score at Site 4, indicating that other variables such as habitat degradation probably play a role in structuring the macroinvertebrate community here.

Onondaga Creek Site 1 - Tully Farms Road

Site 3, the most upstream location sampled in Onondaga Creek, is upstream of most known pollution sources, including the mudboils. This site was measured as not impacted based on NYSDEC criteria with a water quality value of 7.6, and was considered to be "natural" when NYSDECs Impact Source Determination (ISD) was calculated (Table 3 Figure 5). This site was the only site sampled in this study to be designated as non-impacted. The site is dominated by mayflies (49%), chironomids (21%) and stoneflies (14%) (Figure 6). Mayflies and stoneflies are considered to be generally intolerant of pollution, another indication of the very good water quality at this site. The Chironomid species are considered "facultative", that is, tolerant of a range of water quality conditions.

The NYSDEC score for HBI (7.6) corresponded very well with the overall NYSDEC designation of not impacted conditions (Figure 5). Only 1% of the community was composed of oligochaetes. The HBI score combined with the low percent oligochaetes indicates that this site is not affected by organic material.

Onondaga Creek Site 2 – Webster Road

Site 2 is upstream of all CSO discharges but below a large dairy operation and mudboils. Cattle have direct access to upstream areas and cattle barns are located on hillsides where runoff can go directly into the stream. Occasional surges of turbid, high chloride water from the mudboils also affect the stream in this area. The macroinvertebrate community was composed mostly of facultative chironomids (41%) and tolerant oligochaetes (23%) (Figure 6). This site was measured as slightly impacted based on NYSDEC criteria with a water quality value of 6.3 (Table 3 Figure 5). NYSDEC ISD results were consistent with sewage effluent/animal waste. As no sewage effluent enters the stream in this area it is likely that waste from the dairy farm is the major source of organic enrichment at this site. This is further demonstrated by a drop in NYSDEC HBI score from 7.4 at Site 3 to 5.4 at this location and the increase in the percent oligochaetes from 1% to 22%. Any additional impact due to the mudboils is not obvious from these data. Overall, the macroinvertebrate community at this site shows evidence of slight impacts, likely a result of the combined influence of the animal waste and possibly discharges from mud boils.

NYSDEC sampled this site in 1989 with almost identical results (Figure 7). As in 2000, water quality was judged to be slightly impacted, with a score of 6.0. The HBI score (5.3) in 1989 was very similar to the 2000 score indicating impacts from organic enrichment have remained nearly the same. Since 1989 remediation of the mudboils has taken place: pressure release wells have been dug and a retention basin used to trap sediments has been constructed. These remediation efforts have drastically reduced the amount of sediments that flow into the creek (USGS 1999). However, data do not indicate that remediation of the mudboils has affected the macroinvertebrate community at this site.

Onondaga Creek Site 3 - Dorwin Ave. Bridge

Site 3 is upstream of all CSO discharges but is likely influenced by urban runoff and previous dredging of the channel. The site was considered to be slightly impacted based on NYSDEC criteria, with a water quality value of 6.2, which is almost identical to Site 2 (Table 3, Figure 5). NYSDEC ISD indicated that siltation was the major factor structuring the community at this site. Facultative chironomids (39%) and caddisflies (33%) were the most abundant organisms present (Figure 6). The slight recovery in the NYSDEC HBI score, from 5.4 to 6.2, and the decrease in percent oligochaetes, from 22% to only 4%, could be related to the distance of this site from Site 2 where agricultural impacts were clear. These results suggest that siltation is the major structuring element affecting the macroinvertebrate community at this site.

This is only one of two sites in this study (the other is Site 3 in Harbor Brook) sampled with the same methodology in 1999 and 2000. Scores from 1999 and 2000 are almost identical (Figure 7) suggesting that little has changed at this site in the past year.

Onondaga Creek Site 4 – Spencer Street

Site 4 is downstream of more than 50 CSO discharges and long reaches of stream that have been dredged, straightened and concreted. Even though adequate bottom substrate was present, this location was found to be borderline moderately/severely impacted based on NYSDEC criteria, with a water quality value of 2.5 (Table 3, Figure 5). NYSDEC ISD was inconclusive since similarity to NYSDEC models was less than 50% for all comparisons. Tolerant oligochaetes (43%), leeches (34%), and facultative chironomids (20%) represented almost 100% of the community at this site (Figure 6). The drop in HBI score and increase in percent oligochaetes as compared to upstream sites indicates that organic enrichment has adversely affected the macroinvertebrate community in this site. However, the difference in HBI between this site and the others does not fully account for the extreme drop in the NYSDEC assessment score. Other variables, such as habitat degradation, probably play a role in structuring the macroinvertebrate community in this area of Onondaga Creek.

NYSDEC sampled this site in 1989 and there has been a noticeable improvement in water quality over the 11-year period (Figure 7). In 1989 this site was judged to be severely impacted, with a score of only 1.2. In 2000 this value had risen to 2.5.

3.3.1.2. Ley Creek

The macroinvertebrate community in Ley Creek is consistent with moderately impacted conditions at all three monitoring points, based on NYSDEC criteria that range from 2.8 to 4.7 (Table 4, Figure 8). Moderate impairment is evident upstream of CSO discharge points as well as downstream. Although all sites were measured as moderately impacted, Site 4 was just above the criteria for being severely impacted and was significantly lower than Sites 1 and 2 ($p < 0.05$). HBI scores and the percent oligochaetes indicate greater impact from organic pollution as the stream moves downstream.

Ley Creek Site 1-- Townline Road

Site 3 is upstream of all CSO discharge points but receives some urban and industrial runoff. This location was considered to be moderately impacted based on NYSDEC criteria, with a water quality value of 4.7 (Table 4, Figure 8). Facultative amphipods (44%) and tolerant oligochaetes (36%) dominated the site (Figure 9). The HBI score (6.4) and the percent oligochaetes indicate organic enrichment. NYSDEC ISD indicated that impacts to this site were from municipal/industrial sources. However, since the ISD criteria were developed using kick samples in riffles and data at this site were collected with jab samples because of low velocity and silty substrate (the entire stream is slow moving), all ISD results should be interpreted with caution.

Ley Creek Site 2 – 7th North Street

Site 2 is upstream of all CSO discharges but is influenced by increasing levels of urbanization and possible leaching from municipal landfills and industrial disposal sites. This site was deemed moderately impacted based on NYSDEC criteria, with a mean water quality value of 4.2 (Table 4, Figure 8). Community structure was similar to that found at Site 3 with oligochaetes (38%), chironomids (25%) and amphipods (21%) dominating (Figure 9). The significant ($p < 0.01$) decrease in HBI score (3.5) from Site 3 indicates increased impacts from organic enrichment. NYSDEC ISD indicated that impacts to this site were from sewage effluent/animal waste.

Ley Creek Site 3 – Park Street

Site 3 is below two CSO discharges in Ley Creek. The stream at this location is moderately impacted based on NYSDEC criteria, with a water quality value of 2.8 (Table 4, Figure 8). The lower water quality value represents a significant decrease from both Sites 1 ($p<0.001$) and 2 ($p< 0.05$). The decrease in the HBI score (2.2) and increase in percent oligochaetes (63%) indicates that much of the change between sites is probably due to organic enrichment (Figures 8 and 9). However, impacts from organic enrichment were evident at the upstream sites. NYSDEC ISD, as in Site 3, indicates that the source of impact is from municipal/industrial origins. The potential for backflow of Onondaga Lake water at this site appears to be great, especially in light of the occurrence of oncolites collected in the jab samples. The potential impacts to this site from lake backflow are not known. It appears that CSO discharges may confound the already substantial degradation of the stream at this site.

3.3.1.3. Harbor Brook

The macroinvertebrate community in Harbor Brook was severely impacted at all sites in 2000, with NYSDEC water quality criteria ranging from only 0.5 to 2.1 (Table 5, Figure 10). Severe impairment is evident upstream of CSO discharge points as well as downstream. HBI and percent oligochaetes indicate that organic enrichment is a major contributor to the severely impacted conditions at all sites. Site 3 at Velasko Rd. showed a significant ($p < 0.05$) decrease in water quality and HBI scores compared to 1999. Site 2 at Hiawatha Blvd. has remained nearly unchanged (i.e., very severely impacted) since a 1989 NYSDEC study.

Harbor Brook Site 1– Velasko Road

This site is the most upstream location that can be sampled in Harbor Brook as upstream areas are intermittent in most years. This location is upstream of CSO discharges. The site was deemed severely impacted in 2000 based on NYSDEC criteria, with a mean water quality value of 1.9 (Table 5, Figure 10). The site was dominated by oligochaetes (67%) and by chironomids (22%) (Figure 11). The HBI score (1.7) and dominance of oligochaetes suggests that much of the observed impact is from organic enrichment. Since this site is upstream of CSO discharges, these organic impacts must be due to other sources. NYSDEC ISD indicates that the source of impact is from municipal/industrial origins.

This site was sampled with the same methodology in both 1999 and 2000. Both the overall NYSDEC score and the HBI scores were significantly lower ($p<0.05$) in 2000 (1.9 and 1.7 respectively) than they were in 1999 (4.4 and 7.1 respectively) (Figure 7). The drop in HBI score was also significant ($p<0.0005$) going from a point where the score would be considered nearly non impacted to severely impacted in only one year. The cause of the severe drop in water quality at this site is unknown.

Harbor Brook Site 2 – Hiawatha Blvd

Site 3 is downstream of all CSO discharges and close to where the stream resurfaces after being underground for about 2 km. The stream at this site runs through an area of old wastebed material. The streambed at this site is predominantly silt covered concrete with varying amounts of debris, such as discarded tires. This site was the most severely impacted of any of the study locations in this study, with a NYSDEC water quality value of only 0.5 (Table 5, Figure 10). Oligochaetes represented 91% of the community and the HBI score was an extremely low 0.1, indicating severe impacts from organic pollution (Figures 10 and 11). NYSDEC ISD indicates that the source of impact is municipal/industrial. The severe conditions at this site are probably a culmination of habitat degradation, organic enrichment and the effects of piping through the urban corridor.

In 1989 NYSDEC sampled at this site and concluded that the macroinvertebrate community was consistent with toxic rather than conventional pollutants (Bode et al. 1989). The water quality and HBI scores between the two studies are almost identical (Figure 7). Water quality scores were 0.6 in 1989 and 0.5 in 2000. HBI scores were 0.4 in 1989 and 0.1 in 2000. Conditions have not changed over 11 years.

Harbor Brook Site 3 - Rt. 690

Site 3 is the most downstream site in Harbor Brook and is approximately 300 m downstream of Site 2. This location is near where the brook enters Onondaga Lake. At this location the stream flows through areas composed mostly of wastebed material and probably receives backwash from Onondaga Lake. This site was found to be severely impacted based on NYSDEC criteria, with a water quality value of 2.1 (Table 5, Figure 10). This site was similar to Site 3 both in water quality score (2.1 and 1.9 respectively) and HBI score (1.0 and 1.7 respectively). As with Site 3 this location was dominated by oligochaetes (62%) and to a lesser extent chironomids (30%) (Figure 11).

3.3.2 Lake Macroinvertebrates

The macroinvertebrate community of the littoral zone of Onondaga Lake in 2000 is characterized as slightly to severely impacted based on NYSDEC criteria, with mean water quality scores ranging from 0.7 to 5.3 (on a scale of 0 to 10) (Table 6). Only Sites 2 and 5 were not significantly different from each other based on NYSDEC criteria ($p<0.05$), indicating that conditions vary spatially within the lake (Figure 12A). Although 53 distinct taxa of macroinvertebrates were collected in the lake, oligochaetes account for 55 to 98 % of the taxa present in the five sites sampled (Figure 12C). Most of the oligochaete species that abound in the lake can tolerate wide ranges of both eutrophication and salinity (Bousfield 1973, Brinkhurst and Cook 1980, Wagner 1998, Welch 1980). For example, two taxa of oligochaete worms abundant in Onondaga Lake, immature tubificid spp. (probably mostly immature *Limnodrilus hoffmeisteri)* and mature *Limnodrilus hoffmeisteri*, typically dominate in systems that receive high volumes of organic waste (Welch 1980, Brinkhurst and Cook 1980).

Sites in the north end of the lake (Sites 3 and 4) had the least impacted conditions in 2000 and sites in the south had the most evidence of impact (Sites , 2 and 5). Site 1 at the south end of the lake was the most adversely affected area, receiving a "severely impacted" rating based on NYSDEC criteria. Site 4 on the northeast shore was the least affected site and was considered only "slightly impacted" based on NYSDEC criteria. The combined influence of eutrophication and habitat degradation are likely the major structuring elements of the benthic community in Onondaga Lake.

The 2000 sampling effort is considered to be the baseline effort. The 1999 study was used to estimate variability in the dataset and use the results to finalize design of the sampling program. 1999 data were collected in July; and 2000 were collected in June. Future sampling efforts of the lake's macroinvertebrate community will take place in June in order to be standardized with the 2000 baseline effort. Comparison of results from 2000 to those for 1999 shows both similarities and some differences (Figure 13). The interpretation of results between these two years should be done with caution because of the difference in sampling date.

A significant decline in NYSDEC water quality assessments was noted at Sites 2 and 4 (Wastebeds and Ley Creek) from 1999 to 2000 (Figure 13A). The decline in NYSDEC assessments at Site 2 was due to a decrease in all five metrics used to calculate the overall assessment, with the decrease in HBI score being most pronounced. The decline in NYSDEC assessments at Site 5 was due primarily to a 4.1 drop in score for PMA. HBI score at Sites 2, 4 and 5 (Wastebeds, Hiawatha Point, and Ley Creek) showed a significant decline from 1999 to 2000. The decline in NYSDEC assessments and HBI score at some sites may be related to higher proportions of oligochaetes and zebra mussels observed in 2000, and their impact on the metrics used to calculate the NYSDEC assessments.

Oligochaetes were present in significantly higher proportions at four of the five sites, due largely to the presence of large numbers of *Nais elinguis* and other *Nais* spp. not present during the 1999 sampling. The presence of *Nais* worms in 2000 is probably due to sampling in June when *Naidae* typically reproduce in large numbers. Chironomids were present in much lower proportions at all sites in 2000. The overall changes in community structure between 1999 and 2000 may be due to natural population fluctuations, weather patterns and/or the time of sampling.

Only a total of five zebra mussels (*Dreissena polymorpha*) were collected in Petite Ponar samples in 1999. In 2000 they were present at densities of about 2,200 organisms per square meter with a range of 130 to 5100 per square meter (Figure 14). Zebra mussels were most abundant at Sites 2 and 3 (Wastebeds and Maple Bay), intermediate at Site 4(Hiawatha Point) and low at Sites 1 (Metro) and 5 (Ley Creek). The distribution of zebra mussels in the lake seems to be generally related to substrate composition and wave energy. The sites with the highest densities are both on the western shore and, thus, largely protected from the wind. The wastebed site has the added feature of a hard crust layer that appears to provide excellent anchoring substrate for zebra mussels. Site 4 has a high proportion of oncolites. This moderately hard substrate type would seem to provide adequate substrate for mussel colonization. However, the high wave energy at this site combined with the low density and thus easily disturbed oncolites may preclude significant colonization of zebra mussels in this area of the lake. The fine sediments of Site 1 are not ideal substrate for zebra mussel colonization so it is not surprising that densities were low in this area.

3.3.2.1. Site 1 – Metro

Site 1, located close to the discharge of Metro on the south shore, was the most impacted site in the lakes littoral zone. This site was classified as severely impacted based on NYSDEC criteria with a mean water quality value of only 0.7, the same as in 1999. The HBI score was the worst possible (10 on a scale of 0 – 10) due to the community dominated by tolerant oligochaetes (99%). Density of macroinvertebrates was significantly higher than at any of the other sites in 2000 (67,782 organisms/m^2). These results are typical of macroinvertebrate communities found near sewage effluent discharges (Welch 1980). As lakes become more organically enriched it is common to find high densities of tubificid oligochaetes such as *Tubificid spp.* and

Limnodrilus hoffmeisteri (Brinkhurst and Cook 1980). Low concentrations of dissolved oxygen are typically associated with organic enrichment (Wetzel 1983). Extremely low concentrations of DO are lethal to a majority of littoral macroinvertebrates (Welch 1980, Brinkhurst and Cook 1980, Wetzel 1983). These conditions typically result in communities dominated by large numbers of very few species. The high density of tolerant species at these sites is due to an abundant food supply coupled with reduced intraspecific competition and predation (Welch 1980).

In 1999 the density of macroinvertebrates at this site was lower than at most other sites in the lake. This is not typical of areas in proximity to sewage outfalls. Much of the higher density in 2000 is due to the presence of the oligochaete *Nais elinguis*. This species typically reproduces in great numbers during May and June when water temperatures in New York are ideal. This species was represented by only a single individual in 36 replicates during July 1999 but had an average density of 46,365/m^2 in June 2000. If densities at Site 3 in 2000 are calculated without *Nais elinguis* the result is about 22,000 organisms/m^2, still higher than the other lake sites and substantially higher than this same site in 1999.

3.3.2.2. Site 2 – Wastebeds

Ponar samples

Site 2 is located on the wastebeds along the southwestern shore and is considered moderately impacted based on NYSDEC criteria, with a water quality value of 2.9, which is significantly less than the value calculated in 1999 for this site (5.0). The decline in NYSDEC assessment at this site from 1999 to 2000 was due to a decrease in all five metrics used to calculate the overall assessment; the drop in the HBI score was most pronounced. The increase in dominance of both oligochaetes and zebra mussels at this site, combined with a decrease in chironomids, probably explains the decline in the metrics and ultimately the NYSDEC assessment score.

Oligochaetes (56%) and zebra mussels (38%) were the most abundant taxa at this site in 2000. This represents a considerable change in community structure from 1999 when chironomids represented about 60% of the community. The zebra mussel increase is likely due to a lakewide increase in abundance of this species in 2000 while the increase in the relative proportion of oligochaetes may be due to differences in the time of sampling and/or annual population variability.

Multiplate samples

Figure 15 shows the comparison of results for multiplate samples from Site 2, for 1999 and 2000. Community structure differed greatly between years, with zebra mussels and oligochaetes becoming more prominent in 2000 and chironomids becoming less prominent on a relative abundance scale (Figure 15A). Interestingly, total abundance of macroinvertebrates was significantly greater in 2000 than in 1999 (Figure 15B) there were actually greater number of chironomids collected on the multiplates in 2000 than in 1999 (2487 compared to 842), even though their abundance relative to other taxa decreased greatly. Differences in the metrics between years were small, with only richness being significantly different.

3.3.2.3. Site 3 – Maple Bay

Site 3 is located on the northwest shore in Maple Bay and is farthest from the Metro discharge in the south end of the lake. This site was considered to be moderately impacted in 2000 based on NYSDEC criteria with a mean water quality value of 4.4. This result is almost identical to the score of 4.7 found in 1999, indicating little has changed at this location.

The HBI score at this site (6.0) was the highest (i.e., least affected by organic waste) of all the lake sites in 2000 and was nearly equal to the score from 1999 (6.1). The relatively high HBI score at this site is likely influenced by the distance from the Metro outfall at the south end of the lake and by the tendency of water to move north along the east shore. The benthic community in 2000 generally resembles that of Sites 2 and 4, and is dominated by oligochaetes (72%) and zebra mussels (20%).

Density of macroinvertebrates was significantly higher in 2000 (17,828/m^2) than in 1999 (4,799/m^2) due partly to the presence of zebra mussels in 2000 (3556/ m^2) and their absence in 1999.

3.3.2.4. Site 4 – Hiawatha Point

Site 4, located on the northeast shore at Hiawatha Point, is composed of mostly sandy sediments. As in 1999 (WQ score of 5.5) this site was considered only slightly impacted based on NYSDEC criteria with a water quality score of 5.3 in 2000 (Figure 13A). Oligochaetes dominated the community here (68%) as in other sites in the lake in 2000, but unlike the other sites the percent of oligochaetes was not significantly greater than in 1999 (Figure 15C), although the proportion of tolerant oligochaetes was greater. The mean HBI scores at this site were significantly lower than in 1999, due largely to the increase in the proportion of tolerant oligochaetes. Zebra mussels (21%) and chironomids (11%) made up a substantial portion of the community at the site.

3.3.2.5. Site 5 – Ley Creek

Site 5 is located on the southeastern shore, north of Ley Creek. This area was considered moderately impacted based on NYSDEC impact assessment, with a water quality value of 3.1, a significant decrease from 1999 (4.2) (Figure 12A Table 6). The decrease in impact assessment from 1991 was due almost entirely to a 4.1 drop in water quality score for PMA and a 2.2 drop in the HBI score, both of which were negatively impacted by an increase in the relative abundance of oligochaetes from 1999 (96% in 2000 compared to 58% in 1999). Although some of the increase in oligochaetes was due to an increase in *Nais elinguis* it was not as pronounced as in Site 1. Wagner (1998) hypothesized that wave action moves and redistributes silt, detritus and oncolites between the spaces of heavier sediments providing suitable habitat for oligochaetes. This could explain the high proportion of oligochaetes in an area with such a large amount of coarse sediments and a large fetch.

NYSDEC HBI scores averaged the second lowest in the lake (Figure 12 B). This is probably due to this site's proximity to Site 1 and the tendency of water discharging at the south end to travel in a counterclockwise direction up the east shore.

Section 4. Conclusions

4.1. Tributaries

The macroinvertebrate communities of Onondaga Creek, Ley Creek and Harbor Brook show varying levels of impact. Harbor Brook is the most severely impacted of the tributaries followed by Ley Creek and Onondaga Creek. The combination of habitat degradation, non-point source pollution, and CSO discharges plays a extensive role in structuring the macroinvertebrate communities of the three streams.

Harbor Brook is severely impacted from its most upstream site at Velasko Road to the point where it enters Onondaga Lake downstream of Interstate 690. HBI scores and the percent of oligochaetes at all sites indicate that impact from organic pollution is severe, even upstream of CSO discharges. NYSDEC impact source determination points towards "Municipal/Industrial".

Ley Creek is moderately impacted at all sites. HBI scores and the percent of oligochaetes indicate increasing impacts from organic pollution as sites proceed downstream. Impact source determination indicates a "Municipal/Industrial" origin at the most upstream and downstream sites, but "Sewage Effluent/Animal Waste" origin at the midstream site.

Sites on Onondaga Creek show a wide range of conditions. Site 3 at Tully Farms Road is a "Natural", non-impacted stream according to NYSDEC impact source determination and impact assessment. Site 2, Webster Road, is designated as slightly impacted and shows possible non-point source organic waste impacts from a nearby dairy operation as determined from HBI scores and the percent of oligochaetes. This is further corroborated by the impact source determination of "Sewage Effluent/Animal Waste" at this location, well upstream of any CSO discharges. Mudboil discharges upstream of Site 2 may also affect the macroinvertebrate community here, but differentiation of these impacts from those of organic waste is not possible with these data. Site 3 at Dorwin Ave. shows a similar level of impact as Site 2, with the possibility of a slight recovery from organic waste indicated as a slight increase in HBI score and a significant decrease in percent oligochaetes. Dredged and straightened sections upstream may cause the "Siltation" impact source determination calculated for this site. The most downstream site (downstream of all but one CSO), Site 4 at Spencer Street, is borderline moderately/severely impacted. A drop in HBI score and a significant increase in percent oligochaetes from Site 3 indicates some of this increased impact is due to organic pollution, probably from a combination of urban runoff and CSO discharges. However, severe habitat degradation upstream of this site likely influences the macroinvertebrate community.

Comparisons of the 2000 data to the 1999 data is only possible at two site due to changes in site locations and sampling methods. Site 2 in Onondaga Creek, Dorwin Ave., showed practically no change, while Site 3 in Harbor Brook, Velasko Road, showed a significant decrease in both NYSDEC assessment score and HBI score. The cause of the severe decrease in water quality at this site is unknown.

NYSDEC sampled three of our study sites with comparable methods in 1989. Site 3, Webster Road, in Onondaga Creek and Site 2, Harbor Brook at Hiawatha Blvd., showed very little change in this eleven-year period. Site 4, Onondaga Creek at Spencer Street, showed a substantial increase in both

NYSDEC water quality score and HBI score indicating that there has been some improvement to this section of stream during the past eleven years.

4.2. Lake

The combined influences of eutrophication and habitat degradation appear to be major structuring elements of the benthic community in Onondaga Lake. The macroinvertebrate community in Onondaga Lake's littoral zone ranges from slightly to severely impacted depending upon the location in the lake. Sites in the north end of the lake appear to be less affected than southern sites. The site in close proximity to the Metro discharge was consistent with what would be expected near a wastewater outfall, as conditions here were considered severely impacted. Oligochaetes were the most numerous taxa at each of the five sites and were particularly dominant at Site 1, Metro, and Site 5, Ley Creek. Zebra mussels were rare in 1999 but abundant in 2000, with an average of 2,200 mussels/m^2 and a range across the five sites of 530 to 5137 mussels/m^2. Combinations of oligochaetes, zebra mussels and chironomids accounted for almost 100% of the macroinvertebrate community at all sites.

A significant decline in NYSDEC impact assessment scores was noted at Sites 2, Wastebeds, and Site 5, Ley Creek, from 1999 to 2000. Significant declines in HBI from 1999 to 2000 occurred at Sites 2, 4 and 5. These differences are related to the increase in oligochaetes in 2000, which in turn is probably due to a change in sampling time from July in 1999 to June in 2000. The time of sampling (June) will remain constant for the remainder of the monitoring effort so that variability due to time of sampling is reduced.

Section 5. Literature Cited

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Table 1. Water quality results for each Onondaga Lake tributary site in the 2000 monitoring program.

Site	Temperature °C	Dissolved Oxygen (mg/L)	Specific Conductance (µS)	pH
Onondaga Creek				
Site 1 – Tully Farms Rd.	14	11	488	8.5
Site 2 – Webster Rd.	16	11	1680	8.0
Site 3 – Dorwin Ave.	17	10	1074	8.2
Site 4 – Spencer Street	18	11	1650	8.1
Ley Creek				
Site 1 – Townline Road	19	8	934	7.8
Site 2 – 7th North Street	21	8	978	-
Site 3 – Park Street	22	7	1079	7.8
Harbor Brook				
Site 1 – Velasko Road	15	11	2190	7.7
Site 2 – Hiawatha Blvd.	16	10	2160	7.9
Site 3 – Rt. 690	15	8	2370	7.8

Table 2. Water quality results from each macroinvertebrate monitoring site from Onondaga Lake in 2000.

Site	Temperature °C	Dissolved Oxygen (mg/L)	Specific Conductance (µS)	pH
Onondaga Lake				
Site 1 - Metro	15	9	1210	7.5
Site 2 - Wastebed	17	10	1300	7.8
Site 3 – Maple Bay	17	12	1350	8.0
Site 4 – Hiawatha Point	18	9	2700	7.9
Site 5 – Ley Creek	20	11	1500	7.9

Table 3. Mean index value and corresponding mean NYSDEC water quality scale value from kick samples from monitoring sites in Onondaga Creek in 2000. Superscript numbers in the water quality value row designate statistical significance between site numbers.

Index	Site 1 Tully Farms Road		Site 2 Webster Road		Site 3 Dorwin Ave.		Site 4 Spencer Street	
	Index Mean	NYSDEC WQ Scale Mean	Index Mean	NYSDEC WQ Scale Mean	Index Mean	NYSDEC WQ Scale Mean	Index Mean	NYSDEC WQ Scale Mean
Species Richness	22	**6.3**	30	**8.7**	25	**7.3**	10	**2.2**
EPT Richness	9.8	**7.6**	5.8	**5.0**	5.8	**5.3**	0.5	**0.8**
HBI	4.6	**7.4**	6.2	**5.4**	5.8	**6.2**	6.6	**4.8**
PMA	79	**9.0**	57	**6.1**	56	**6.0**	33	**2.2**
NYSDEC Mean Water Quality Value	**7.6 [4]**		**6.3 [4]**		**6.2 [4]**		**2.5 [1,2,3]**	
Level of Impact	**None**		**Slight**		**Slight**		**Moderate/ Severe**	
NYSDEC Impact Source Determination	*Natural*		*Sewage Effluent/ Animal Waste*		*Siltation*		*Inconclusive*	

Table 4. Mean index value and corresponding NYSDEC water quality value from jab samples from sites in Ley Creek in 2000. Superscript numbers in the water quality value row designate statistical significance between site numbers. *Note that NYSDEC ISD was devised using kick samples. Samples in Ley Creek were collected with jab samples.

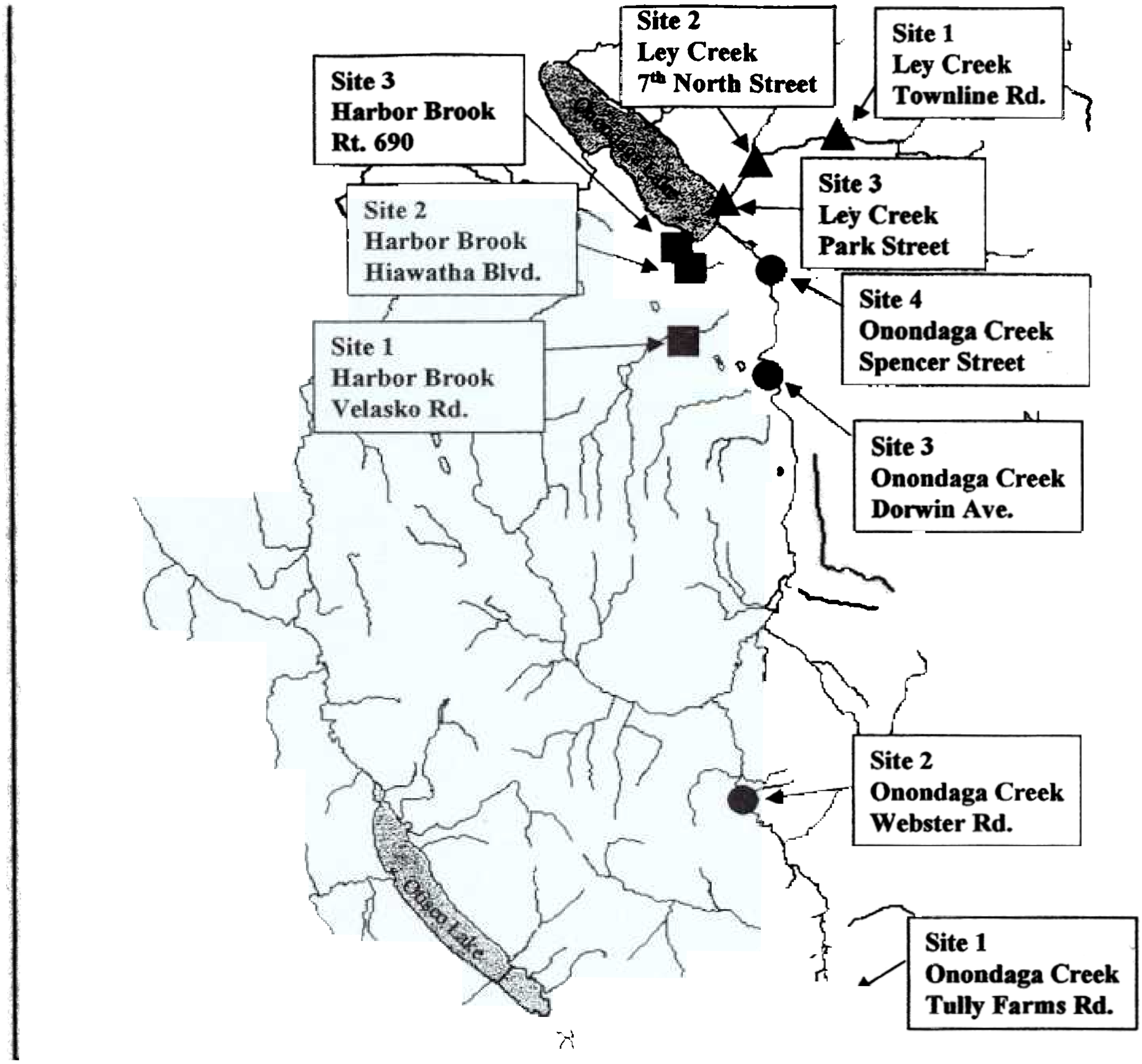
Index	**Site 1 Townline Road**		**Site 2 7th North Street**		**Site 3 Park Street**	
	Index Mean	NYSDEC WQ Scale Mean	Index Mean	NYSDEC WQ Scale Mean	Index Mean	NYSDEC WQ Scale Mean
Species Richness	16	**4.9**	20	**6.9**	15	**4.3**
EPT Richness	1.5	**2.5**	0.25	**0.4**	0.25	**0.4**
HBI	6.1	**6.4**	7.9	**3.5**	8.7	**2.2**
NCO	5.8	**5.2**	7.5	**6.2**	4	**4.2**
NYSDEC Mean Water Quality Value	**4.7** [3]		**4.2** [3]		**2.8** [1,2]	
Level of Impact	**Moderate**		**Moderate**		**Moderate**	
NYSDEC Impact Source Determination	*Municipal/ Industrial**		*Sewage Effluent/ Animal Waste**		*Municipal/ Industrial**	

Table 5. Mean index value and corresponding NYSDEC water quality value from kick and jab samples from sites in Harbor Brook in 2000. Superscript numbers in the water quality value row designate statistical significance between site numbers. *Note that NYSDEC ISD was devised using kick samples. Samples at Site 3 in Harbor Brook were collected with jab samples.

Index	Site 1 Velasko Road		Site 2 Hiawatha Blvd		Site 3 Rt. 690	
	Index Mean	NYSDEC WQ Scale Mean	Index Mean	NYSDEC WQ Scale Mean	Index Mean	NYSDEC WQ Scale Mean
Species Richness	14.8	3.9	8.8	1.7	14	3.8
EPT Richness	0.25	0.4	0	0	0	0
HBI	9.0	1.7	9.9	0.1	9.4	1.0
PMA	30.5	1.9	14.3	0.2	-	-
NCO	-	-	-	-	2.8	3.5
NYSDEC Mean Water Quality Value	1.9 [2]		0.5 [1,3]		2.1 [2]	
Level of Impact	**Severe**		**Severe**		**Severe**	
NYSDEC Impact Source Determination	*Municipal/ Industrial*		*Municipal/ Industrial*		*Municipal/ Industrial**	

Table 6. Mean index value and corresponding NYSDEC water quality value from petite ponar samples from sites in Onondaga Lake in 2000. Superscript numbers in the water quality value row designate statistical significance between site numbers.

Index	Site 1 Metro		Site 2 Wastebeds		Site 3 Maple Bay		Site 4 Hiawatha Point		Site 5 Ley Creek	
	Index Mean	NYSDEC WQ Scale Mean	Index Mean	NYSDEC WQ Scale Mean	Index Mean	NYSDEC WQ Scale Mean	Index Mean	NYSDEC WQ Scale Mean	Index Mean	NYSDEC WQ Scale Mean
Richness	7	1.0	11	2.7	13	3.1	13	3.1	16	4.4
Diversity	4.5	0.9	2.1	3.5	2.5	5.0	2.6	5.6	3.2	7.8
Dominance-3	93	1.7	82	3.7	75	4.9	73	5.2	57	7.9
PMA	21	0.0	38	1.7	44	2.8	25	0.1	44	3.0
HBI	10	0.0	8.8	3.0	7.6	6.0	9.5	1.7	8.6	3.3
Density/M^2	67,782	-	18,042	-	17,828	-	9,872	-	10,611	-
NYSDEC Mean Water Quality Value	$0.7^{2,3,4,5}$		$2.9^{1,3,4}$		$4.4^{1,2,4,5}$		$5.3^{1,2,3,5}$		$3.1^{1,3,4}$	
Level of Impact	Severe		Moderate		Moderate		Slight		Moderate	



Legend	
● Onondaga Creek sites ■ Harbor Brook sites ▲ Ley Creek sites	Figure 1. 2000 Onondaga Lake tributary macroinvertebrate sampling locations.

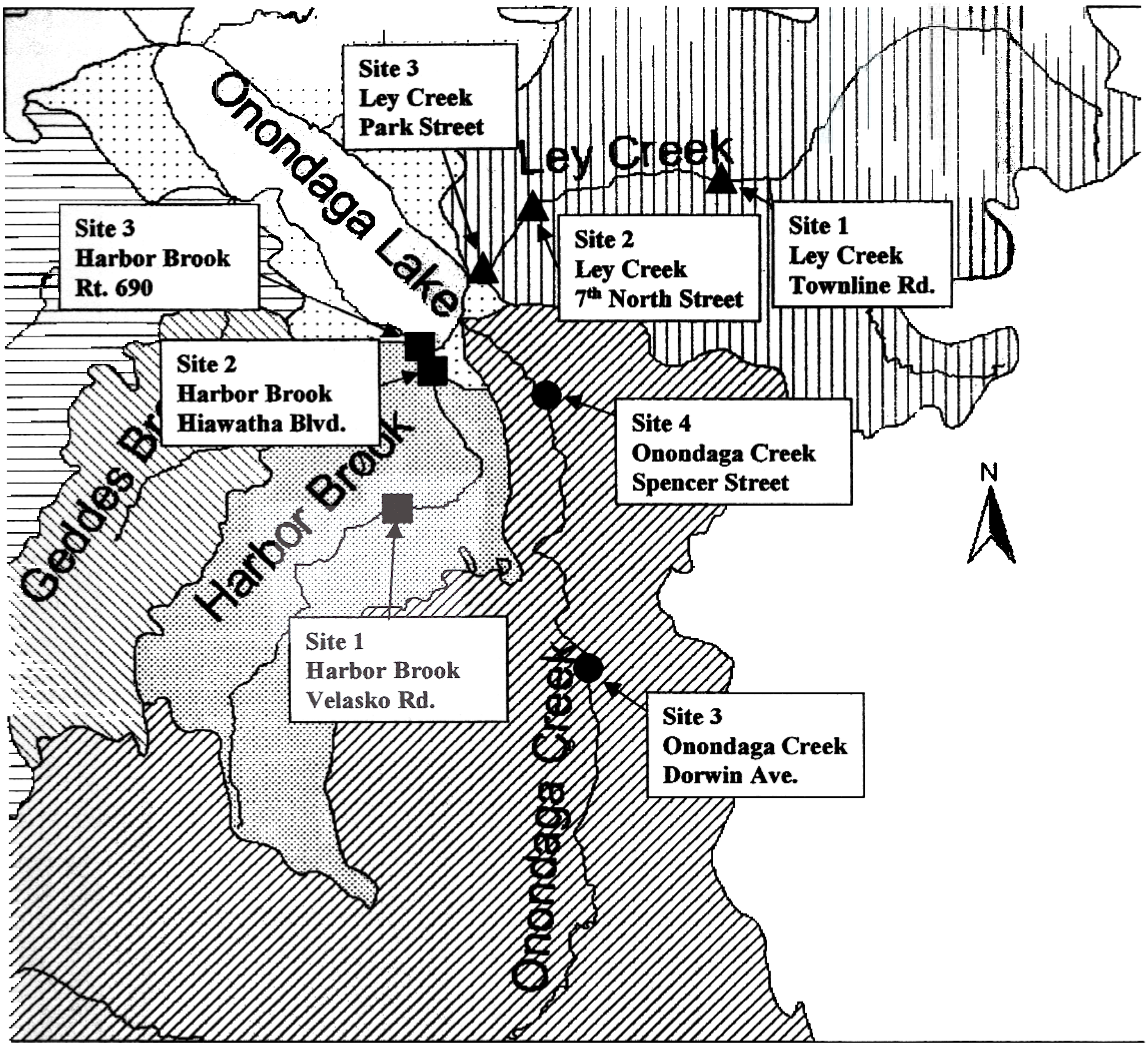
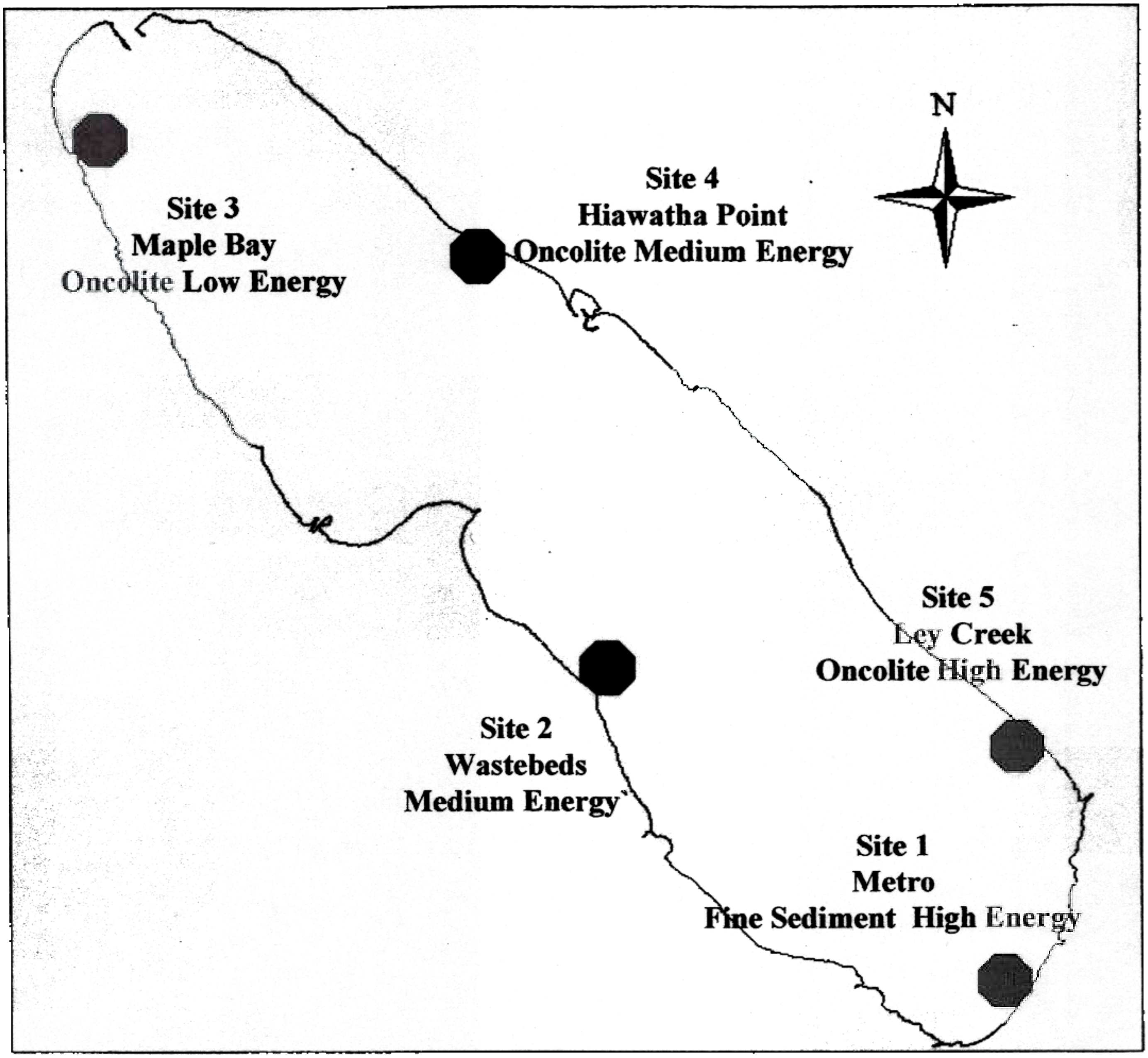


Figure 2. Close up view of 2000 Onondaga Lake tributary macroinvertebrate sampling locations in the City of Syracuse.



Legend

Site Location

Figure 3. 2000 Onondaga Lake macroinvertebrate sampling locations.

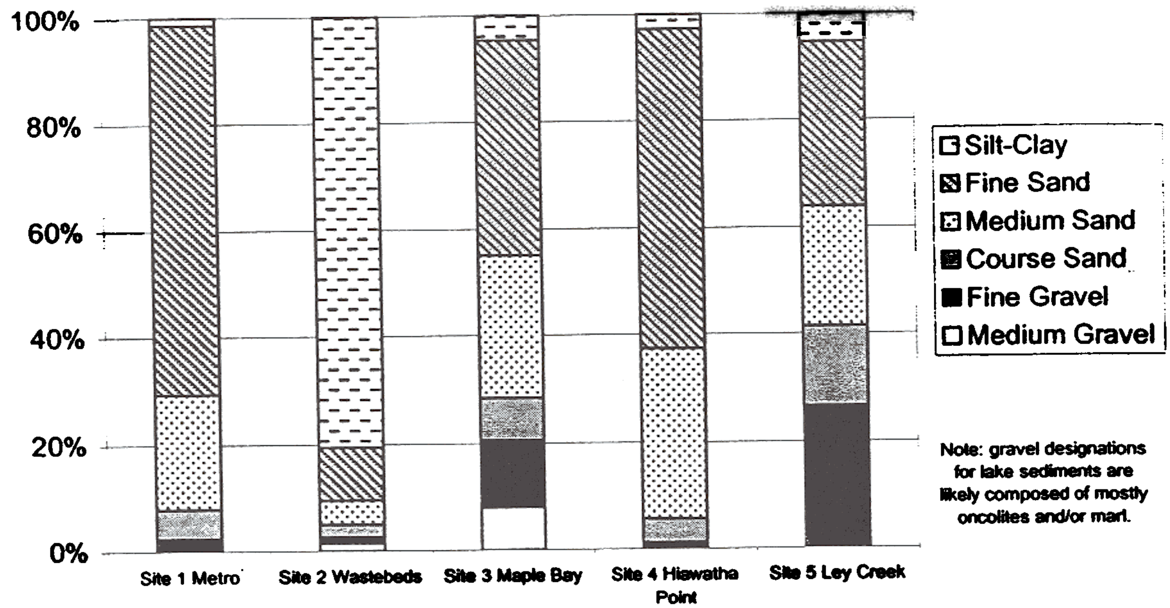
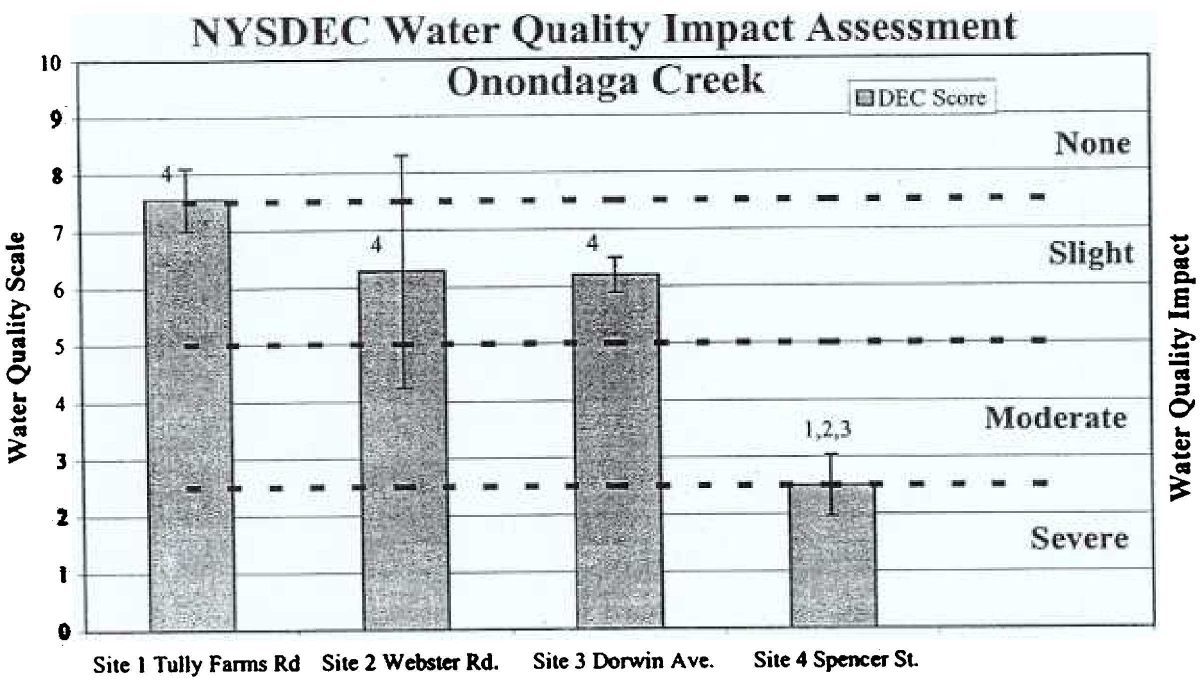


Figure 4. Sediment texture at Onondaga Lake monitoring sites in 2000.



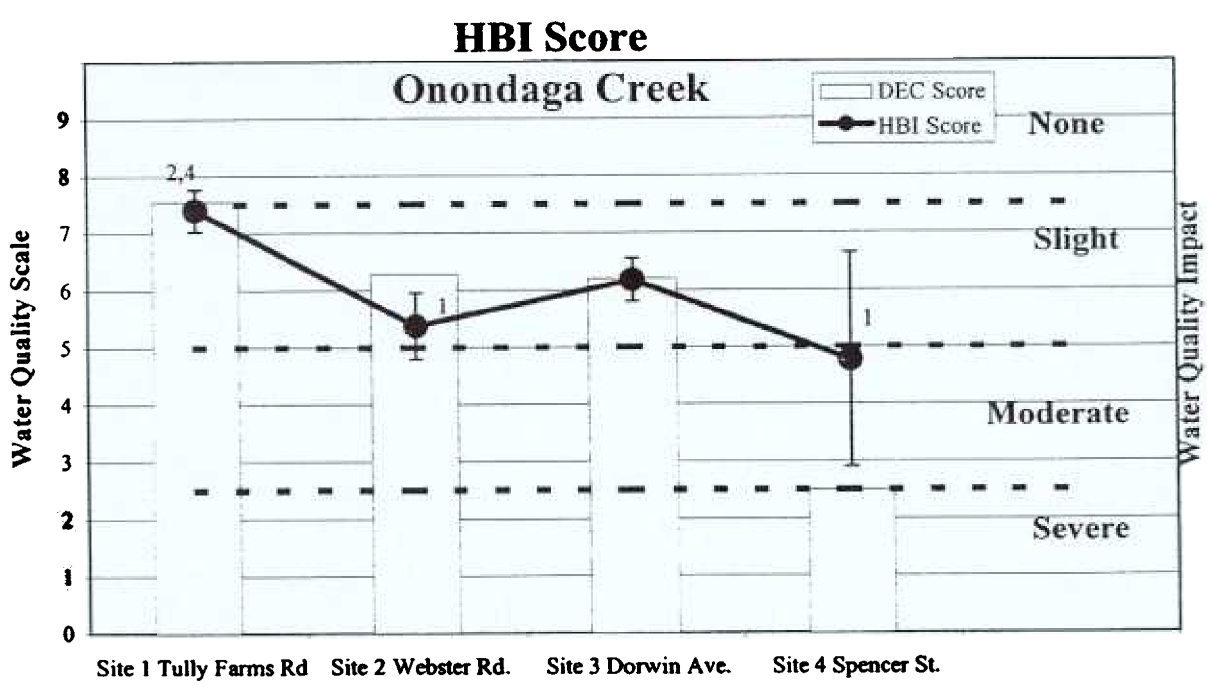


Figure 5. Mean NYSDEC water quality scale scores (top) and superimposed HBI scores (bottom) from monitoring sites in Onondaga Creek in 2000. NYSDEC scores were kept as background bars in the bottom figure to allow comparisons in changes of the overall score and the HBI. Superscript numbers above bars (top) or dots (bottom) designate statistical difference between sites. Error bars are standard deviations.

Onondaga Creek

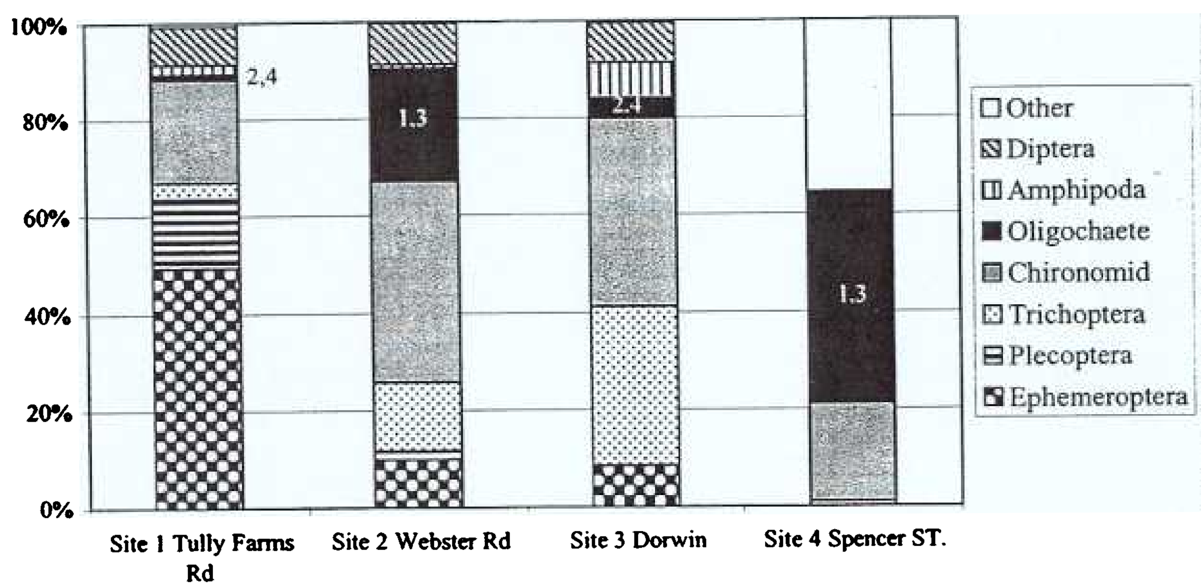
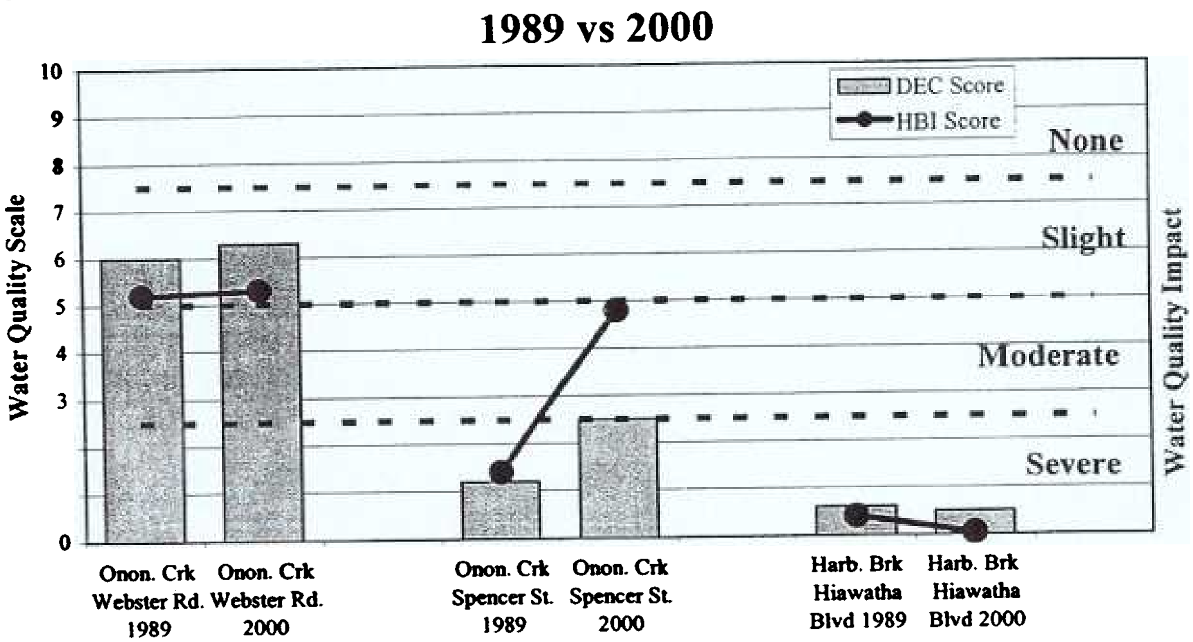


Figure 6. Relative composition of the macroinvertebrate community at monitoring sites in Onondaga Creek in 2000. Numbers within or next to the oligochaete bars indicate statistical difference in the percent oligochaetes between sites.



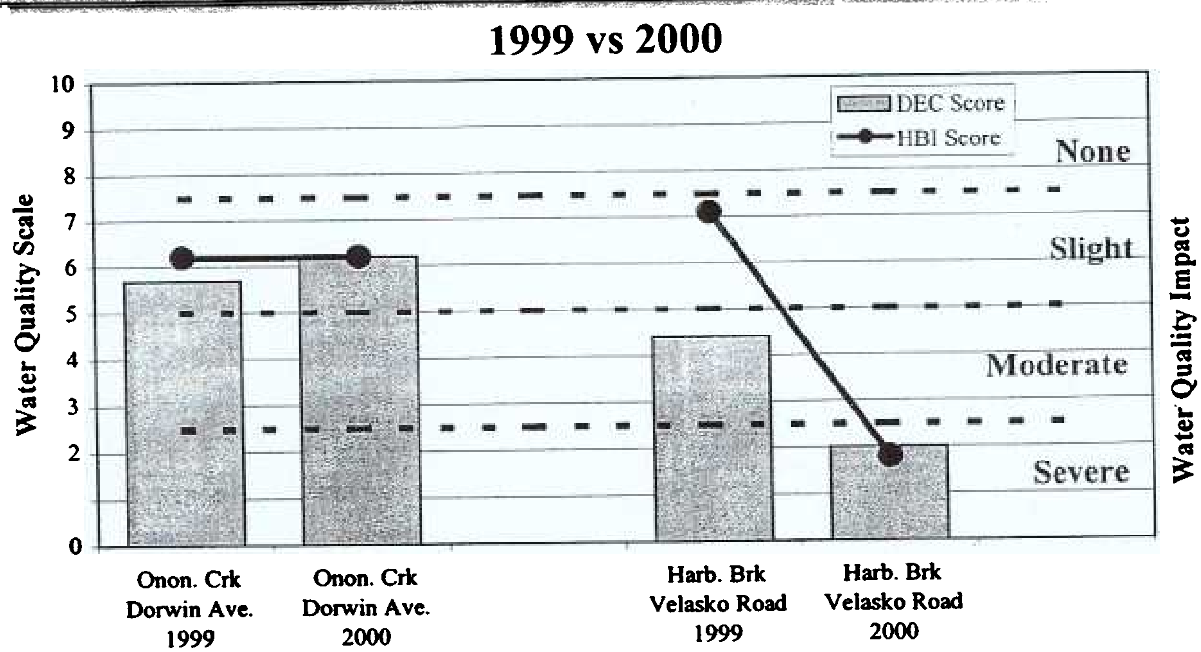
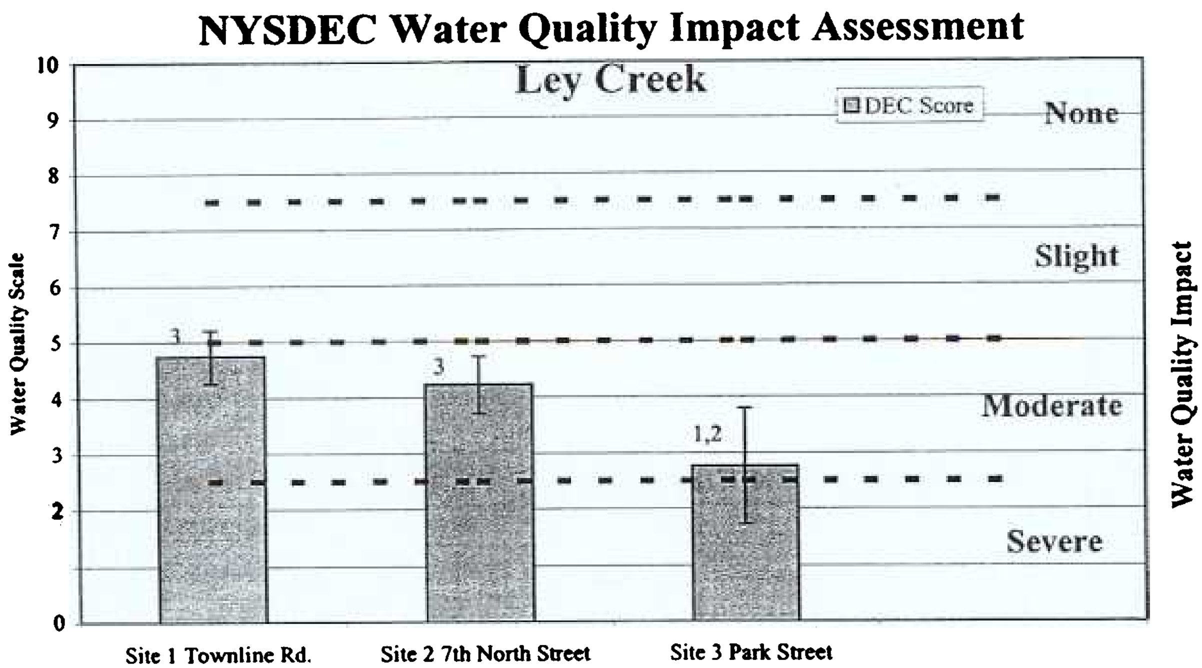


Figure 7. Comparisons of NYSDEC water quality and HBI scores at sites sampled with the same methodology in 1989 (by NYSDEC) and 1999 (by Onondaga County). Both the NYSDEC score and HBI score at Harbor Brook Velasko Road are significantly different between years.



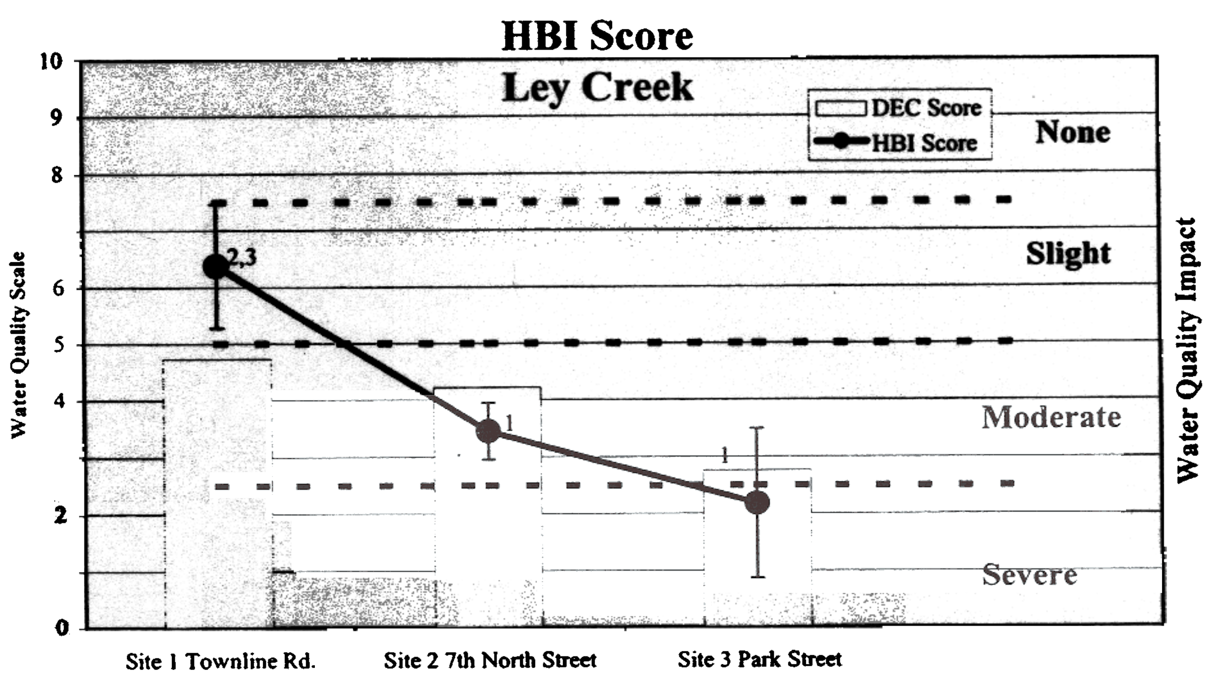


Figure 8. Mean NYSDEC water quality scale scores (top) and superimposed HBI scores (bottom) from monitoring sites in Ley Creek in 2000. NYSDEC scores were kept as background bars in the bottom figure to allow comparisons in changes of the overall score and the HBI. Superscript numbers above bars (top) or dots (bottom) designate statistical difference between sites. Error bars are standard deviations.

Ley Creek

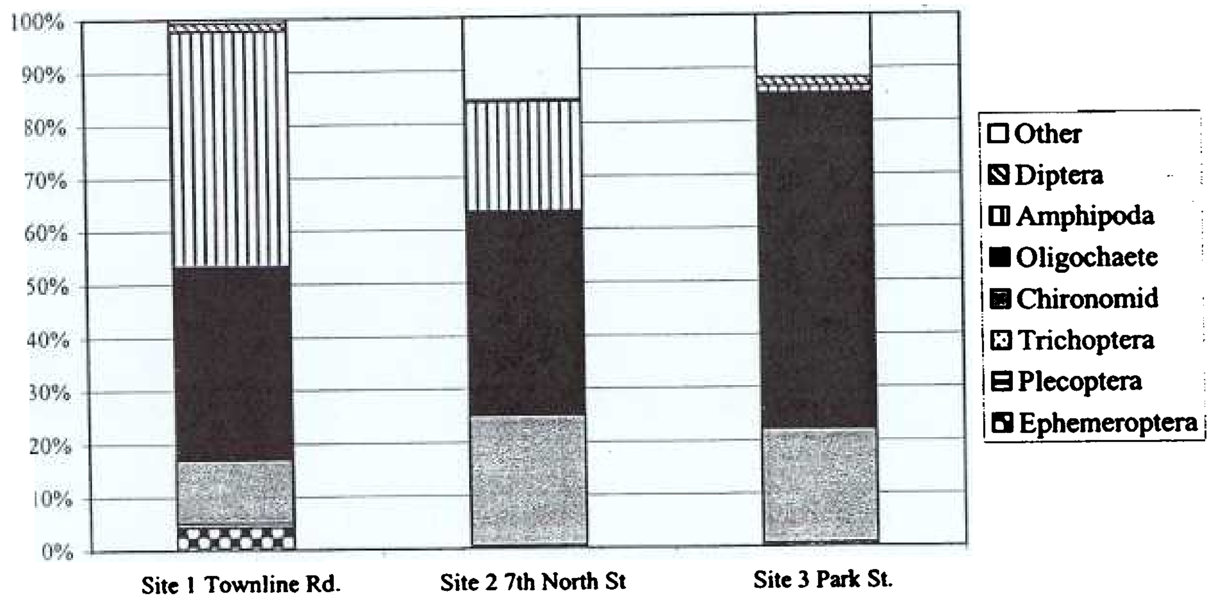


Figure 9. Relative composition of the macroinvertebrate community at monitoring sites in Ley Creek in 2000. There is no statistical difference in the percent oligochaetes between sites.

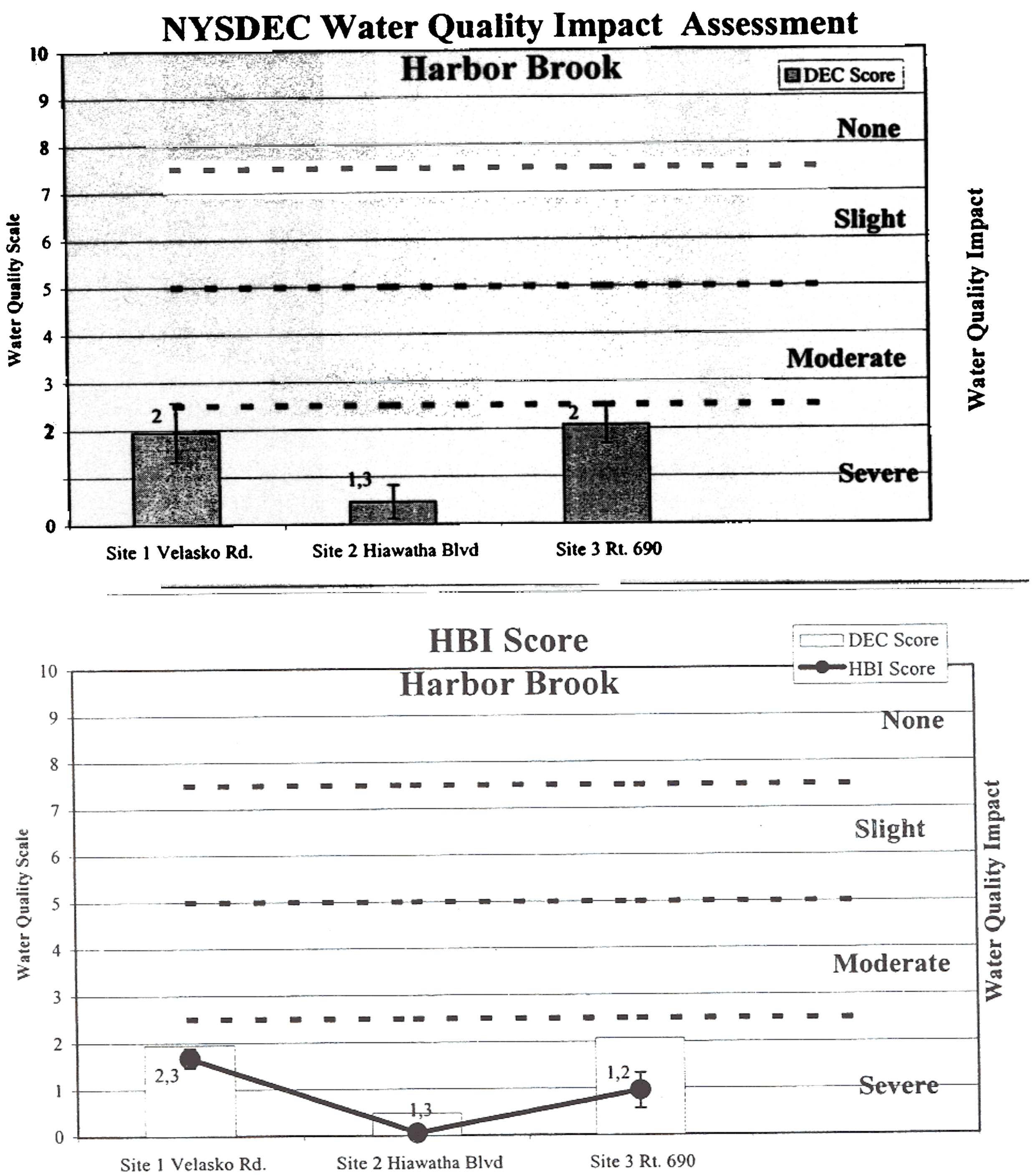


Figure 10. Mean NYSDEC water quality scale scores (top) and superimposed HBI scores (bottom) from monitoring sites in Harbor Brook in 2000. NYSDEC scores were kept as background bars in the bottom figure to allow comparisons in changes of the overall score and the HBI. Superscript numbers above bars (top) or dots (bottom) designate statistical difference between sites. Error bars are standard deviations.

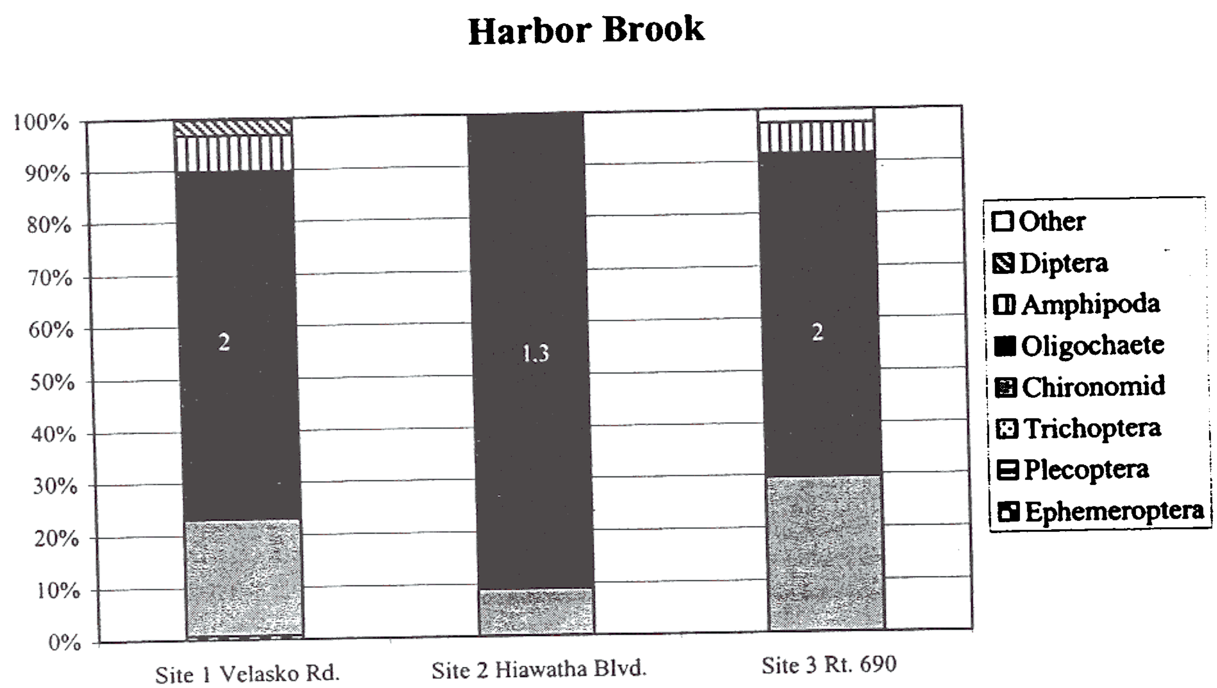


Figure 11. Relative composition of the macroinvertebrate community at monitoring sites in Harbor Brook in 2000.

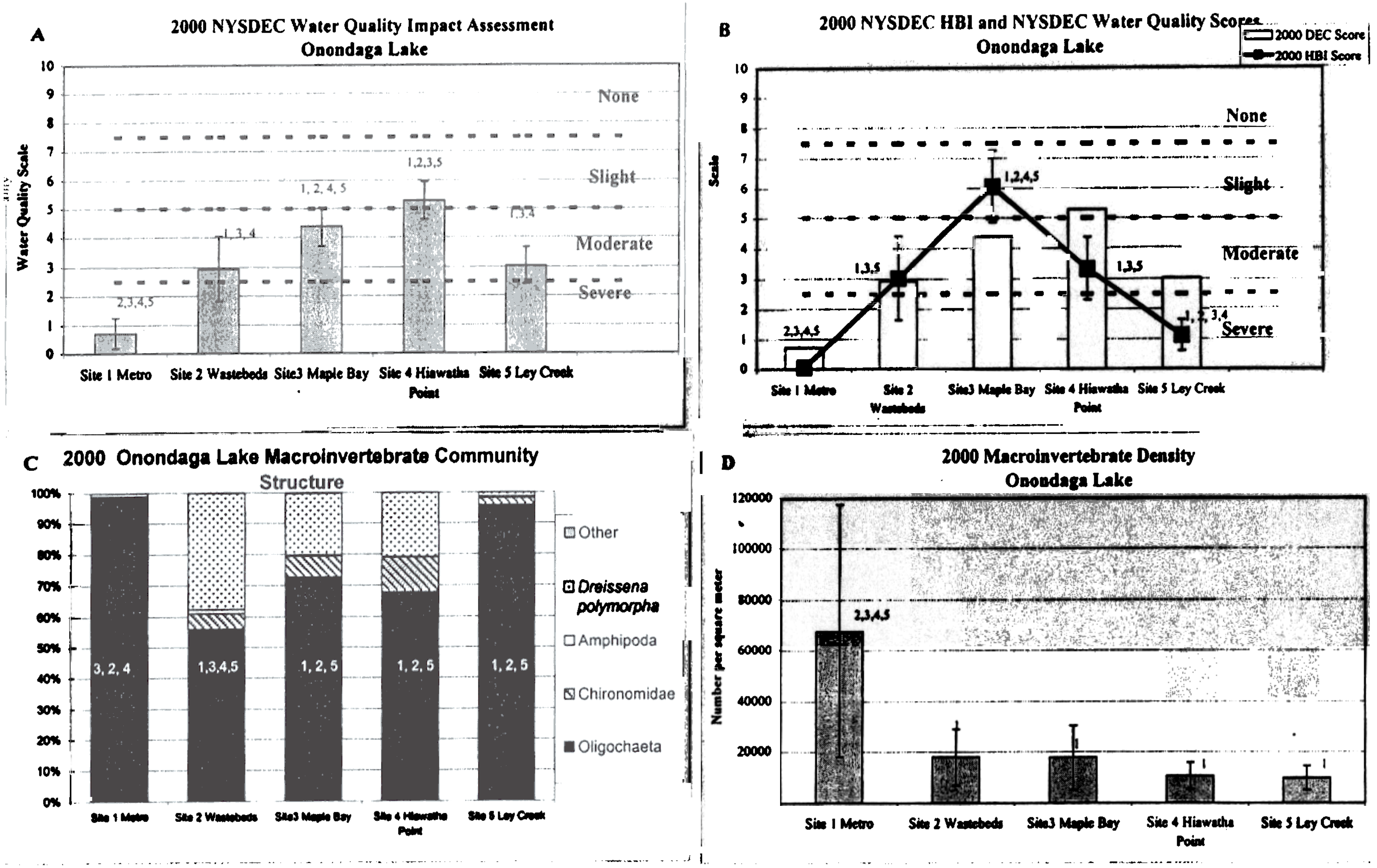


Figure 12. Year 2000 Onondaga Lake macroinvertebrate community results. Numbers above bars in A and D designate statistical difference ($p < 0.05$) between sites. Numbers above points in B designate statistical difference in HBI between sites. Numbers within bars in C designate statistical difference in the percent oligochaetes between sites. Error bars in A, B and D are standard deviations.

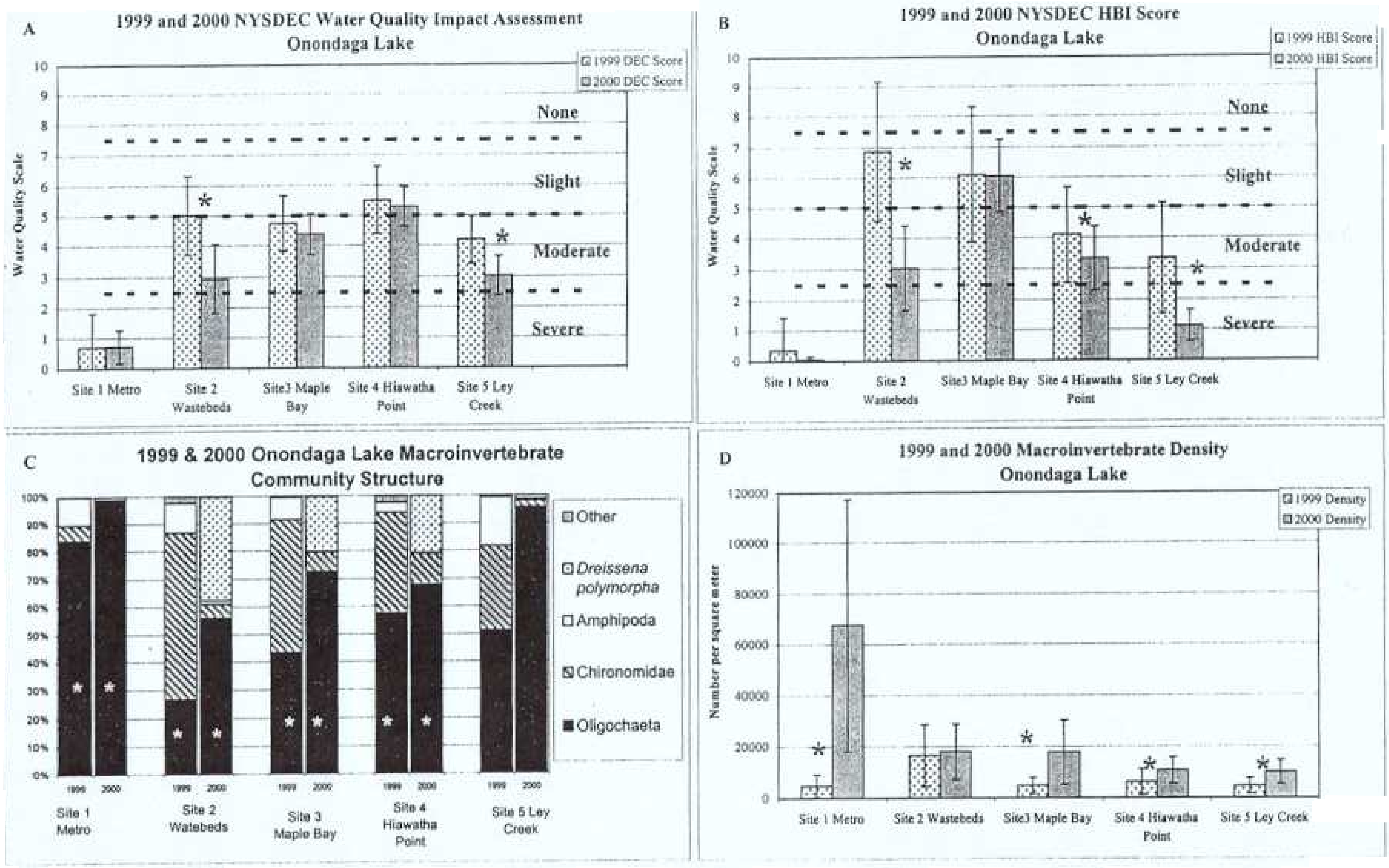


Figure 13. Comparison of 1999 and 2000 Onondaga Lake macroinvertebrate community results. * above bars in A, B and D indicate significant difference ($p < 0.05$) beween years. * within bars in C indicate significant difference ($p < 0.05$) beween years. Error bars in A, B and D are standard deviations.

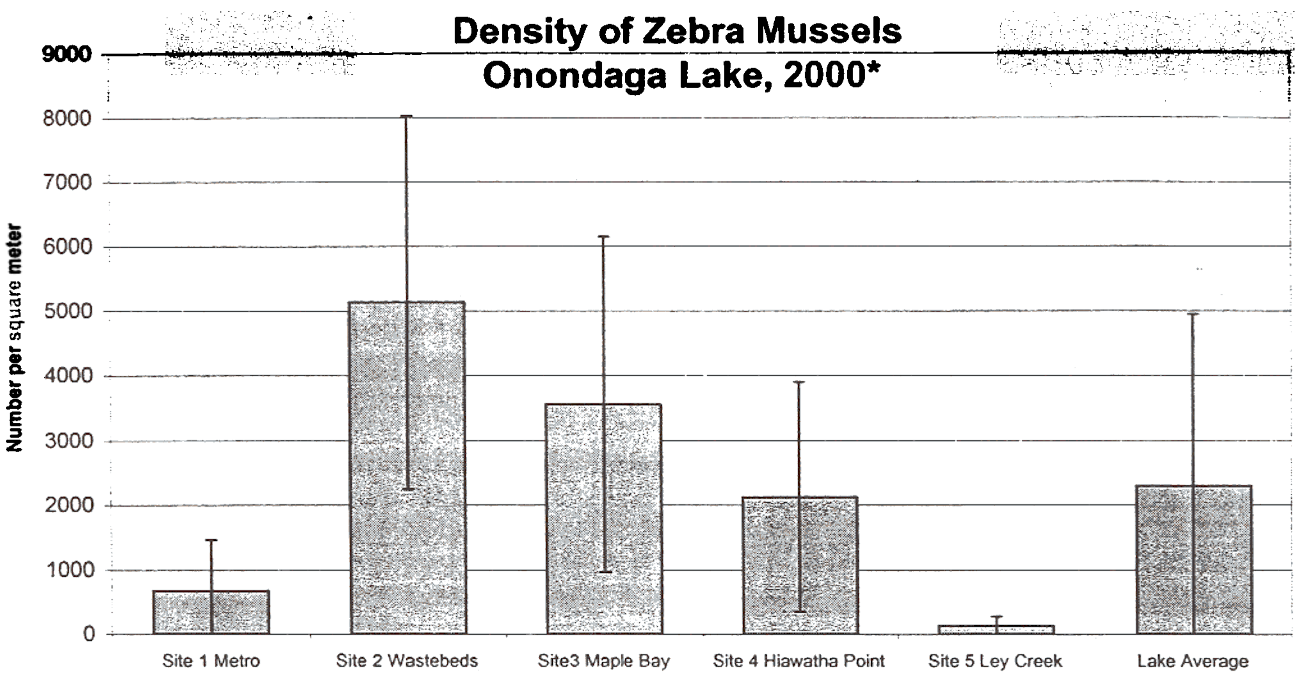


Figure 14. Mean density (#/m^2) of zebra mussels collected at each Onondaga Lake site with Petite Ponars in 2000. Error bars are standard deviations.* Note: In 1999 only five zebra mussels were collected in the entire lake using Petite Ponars.

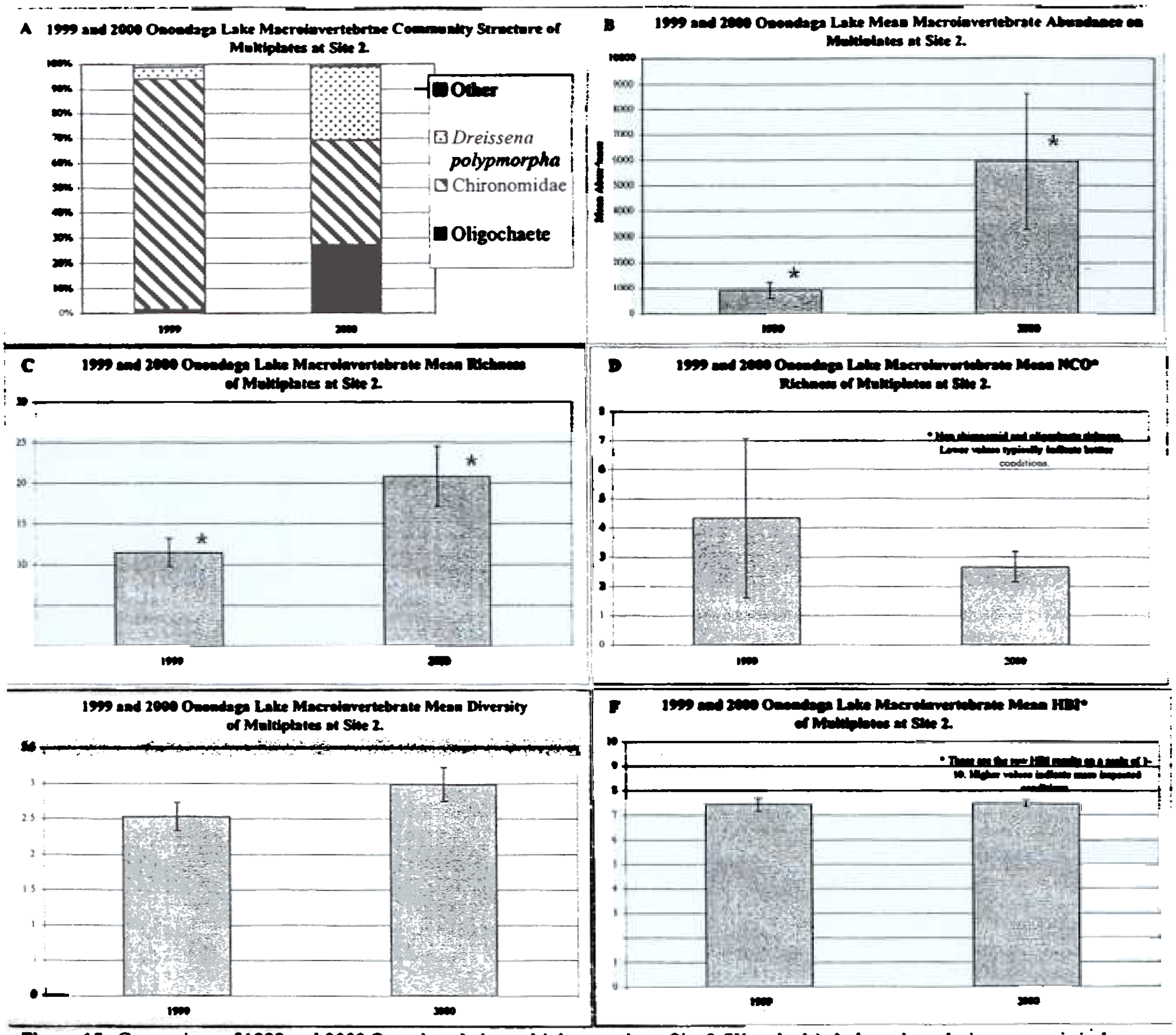


Figure 15. Comparison of 1999 and 2000 Onondaga Lake multiplate results at Site 2 (Wastebeds). * above bars designates statistical difference between years. Error bars are standard deviations.

Appendix A

Taxonomic List

TAXONOMIC LIST OF VOUCHER COLLECTION SPECIMENS FROM ONONDAGA LAKE AND ADJACENT STREAMS, NEW YORK, 1999 - 2000

Platyhelminthes	
Turbellaria	
Tricladida	
Planariidae	
Cura foremanii	J3
Dugesia polychroa	J2
Dugesia tigrina	J1
Cnidaria	
Hydrozoa	
Hydroida	
Hydridae	
Hydra	Y1
Annelida	
Oligochaeta	
Enchytraeida	
Enchytraeidae	L10
Enchytraeus	L39*
Lumbricillus	L38*
Lumbriculida	
Lumbriculidae	L40*
Tubificida	
Naididae	
Amphichaeta leydigi	L29
Chaetogaster diaphanus	L26
Chaetogaster diastrophus	L31
Dero digitata	L7
Dero lodeni	L33
Dero nivea	L25
Dero trifida	L22
Nais barbata	L19
Nais communis	L34
Nais elinguis	L24
Nais variabilis	L18
Ophidonais serpentina	L8
Paranais frici	L42*
Paranais litoralis	L21
Pristina aequiseta	L30
Pristina leidyi	L35
Pristinella jenkinae	L23
Pristinella osborni	L27
Stylaria lacustris	L9
Vejdovskyella intermedia	L16
Tubificidae	
Aulodrilus limnobius	L28
Aulodrilus pigueti	L13
Ilyodrilus templetoni	L17
Limnodrilus cervix	L5
Limnodrilus claparedeianus	L12
Limnodrilus hoffmeisteri	L3
Limnodrilus profundicola	L4
Limnodrilus udekemianus	L2
Quistadrilus multisetosus	L41*
Potamothrix bavaricus	L11
Potamothrix bedoti	L20
Potamothrix moldaviensis	L14
Tubifex tubifex	L6
Lumbricida	
Lumbricidae	
Eiseniella tetraedra	L36*
Allolobophora chlorotica	L37*
Hirudinea	
Rhynchobdellida	
Glossiphoniidae	
Helobdella	H1
Helobdella stagnalis	H3*
Helobdella triserialis	H2
Arynchobdellida	
Erpobdellidae	
Mooreobdella fervida	H5*
Mooreobdella microstoma	H4*
Arthropoda	
Arachnida	
Hydrachnida	
Hygrobatidae	
Hygrobates	W7
Limnesiidae	
Limnesia	W3
Pionidae	
Piona	W2
Torrenticolidae	
Torrenticola	W1
Unionicolidae	
Neumania	W5
Koenikea	W6
Unionicola	W4
Malacostraca	
Amphipoda	
Crangonyctidae	
Crangonyx pseudogracilis	A4*
Gammaridae	
Gammarus fasciatus	A1
Gammarus pseudogracilis	A4*
Gammarus pseudolimnaeus	A2
Hyalellidae	
Hyalella azteca	A3
Isopoda	
Asellidae	

TAXONOMIC LIST OF VOUCHER COLLECTION SPECIMENS FROM ONONDAGA LAKE AND ADJACENT STREAMS, NEW YORK, 1999 - 2000

Caecidotea racovitzai	I2
Caecidotea	I1
Entognatha	
Collembola	
Entomobryidae	
Orchesella	S2
Isotomidae	
Isotomus cf. *sensibilis*	S1
Isotomurus	S3
Insecta	
Ephemeroptera	
Baetidae	
Baetis	E1
Procloeon	E5*
Caenidae	
Caenis	E4
Ephemerellidae	
Timpanoga (Dannella)	E3
Heptageniidae	
Epeorus	E8*
Heptagenia	E6*
Leptophlebiidae	
Paraleptophlebia	E7*
Tricorythidae	
Tricorythodes	E2
Odonata	
Aeshnidae	
Boyeria	N5*
Calopterygidae	
Calopteryx maculata	N1
Coenagrionidae	
Coenagrion/Enallagma	N3
Ischnura	N2
Gomphidae	
Lanthus parvulus	N4*
Plecoptera	
Chloroperlidae	
Sweltsa	P5*
Leuctridae	
Leuctra	P1
Perlidae	
Acroneuria	P3
Agnetina	P2
Pteronarcyidae	
Pteronarcys	P4*
Hemiptera	
Diptera	
Athericidae	
Saldidae	U2
Veliidae	
Rhagovelia	U1
Megaloptera	
Corydalidae	
Nigronia serricornis	M1
Sialidae	
Sialis	M2
Trichoptera	
Glossosomatidae	
Glossosoma	T14*
Hydropsychidae	
Cheumatopsyche	T4
Hydropsyche betteni	T8
Hydropsyche bronta	T6
Hydropsyche slossonae	T2
Hydropsyche sparna	T3
Hydroptilidae	
Hydroptila	T1
Leptoceridae	
Nectopsyche	T12
Oecetis (Pseudosetodes) avara grp.	T9
Philopotamidae	
Chimarra	T7
Dolophilodes	T13*
Polycentropodidae	
Nyctiophylax	T11
Polycentropus	T10
Rhyacophilidae	
Rhyacophila	T5
Lepidoptera	
Pyralidae	
Acentria	LE1
Coleoptera	
Dytiscidae	
Agabus	C2
Elmidae	
Ancyronyx	C9
Dubiraphia	C7
Macronychus	C5
Optioservus	C1
Promoresia	C6
Stenelmis	C4
Haliplidae	
Haliplus	C11
Hydrophilidae	
Berosus	C10
Hydrobius	C3
Lampyridae	C8
Atherix	Z6*
Ceratopogonidae	

TAXONOMIC LIST OF VOUCHER COLLECTION SPECIMENS FROM ONONDAGA LAKE AND ADJACENT STREAMS, NEW YORK, 1999 - 2000

Bezzia/Palpomyia	R1
Monohelea	R2
Mallochohelea	R3
Chironomidae	
Ablabesmyia mallochi	34
Alotanypus	75
Brillia flavifrons	22
Chironomus	81*
Cladopelma	67
Cladotanytarsus	20
Corynoneura	41
Cricotopus bicinctus	7
Cricotopus cf. *intersectus*	83*
Cricotopus sylvestris grp.	44
Cricotopus cf. *triannulatus*	43
Cricotopus trifascia	3
Cricotopus cf. *vierriensis*	39
Cricotopus/Orthocladius	19
Cryptochironomus	27
Cryptotendipes	63
Diamesa	25
Dicrotendipes fumidus	38
Dicrotendipes simpsoni	48
Dicrotendipes modestus	36
*Dicrotendipes neomodestus*37	
Dicrotendipes nervosus	30
Doncricotopus cf. *bicaudatus*	54
Endochironomus	35
Eukiefferiella brehmi grp.	64
Eukiefferiella claripennis grp.	76
Eukiefferiella devonica grp.	13
Glyptotendipes (*Glyptotendipes*)	46
Heterotrissocladius marcidus grp.	29
Labrundinia neopilosella	51
Labrundinia pilosella	47
Larsia	79*
Micropsectra	17
Microtendipes pedellus grp.	4
Nanocladius cf. *minimus*	16
Nanocladius cf. *rectinervis*	70
Natarsia	80*
Nilotanypus fimbriatus	66
Orthocladius (*Euorthocladius*)	73
Pagastia sp. A of Oliver	12
Parachironomus cf. *carinatus*	52
Parachironomus cf. *frequens*	49
Parachironomus cf. *monochromus*	53
Parakiefferiella cf. sp. A of Epler	50
Parakiefferiella cf. sp. B of Epler	69
Tabanidae	
Chrysops	Z5*
Paralauterborniella	61
Parametriocnemus	31
Paratanytarsus	8
Paratendipes	55
Phaenopsectra obediens grp.	15
Phaenopsecra punctipes	32
Polypedilum aviceps	77*
Polypedilum convictum grp.	5
Polypedilum fallax	42
Polypedilum halterale grp.	71
Polypedilum illinoense grp.28	
Polypedilum laetum	14
Polypedilum scalaenum grp.	56
Potthastia gaedii grp.	68
Procladius (*Holotanypus*)	33
Prodiamesa	11
Psectrocladius	82*
Pseudochironomus	
Pseudosmittia	60
Rheocricotopus	45
Rheotanytarsus	23
Stempellinella	78*
Stenochironomus	65
Stictochironomus	74
Tanytarsus cf. sp. A of Epler	9
Tanytarsus cf. sp. C of Epler	10
Tanytarsus cf. sp. E of Epler	72
Tanytarsus cf. sp. G of Epler	40
Tanytarsus cf. sp. L of Epler	62
Tanytarsus cf. sp. P of Epler	26
Tanytarsus cf. sp. T of Epler	58
Tanytarsus cf. sp. W of Epler	18
Thienemanniella cf. sp. A of Epler	57
Thienemanniella cf. *xena*	24
Thienemannimyia grp.	1, 2
Tvetenia bavarica grp.	21
Tvetenia discoloripes grp.	6
Zavrelimyia	59
Empididae	
Chelifera	Q2
Clinocera	Q1
Hemerodromia	Q3
Muscidae	Z1
Psychodidae	
Pericoma	Z3*
Psychoda	Z4*
Simuliidae	
Simulium	Z2
Tipulidae	
Antocha	V3

TAXONOMIC LIST OF VOUCHER COLLECTION SPECIMENS FROM ONONDAGA LAKE AND ADJACENT STREAMS, NEW YORK, 1999 - 2000

Dicranota	V2
Hexatoma	V1
Tipula	V4*
Mollusca	
Bivalvia	
Veneroida	
Dreissenidae	
Dreissena polymorpha	B3
Sphaeriidae	
Musculium	B5*
Pisidium casertanum	B6*
Pisidium compressum	B2
Pisidium punctatum	B4
Pisidium dubium	B1
Gastropoda	
Limnophila	
Ancylidae	
Ferrissia rivularis	G6
Lymnaeidae	
Fossaria	G5
Fossaria rustica	G7
Pseudosuccinea columella	G8
Physidae	
Physa cf. *heterostropha*	G1, G4
Planorbidae	
Gyraulus circumstriatus	G2
Micromenetus dilatatus	G3

* Taxa added from the samples collected in 2000.

Alphanumeric/numeric designation following taxon pertains to the code found in the vial/on the vial lid or on the microscope slide.

Appendix B

Lake Macroinvertebrate Petite Ponar Data

Appendix B. Raw data of 2000 Onondaga Lake macroinvertebrate petite ponar samples.

Facility Code	3001	3002	3003	3004	3005	3006	3007	3008	3009	3010	3011	3012	3013	3014	3015	3016	3017	3018	3019	3020	3021	3022	
Site number	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
Replicate #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Chaetogaster diaphanus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dero digitata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nais bretscheri	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nais communis/variabilis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nais elinguis	576	552	516	2730	3036	360	390	560	498	18	1485	882	2376	1520	153	630	945	176	1131	2838	888	1008	2646
Nais pardalis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nais barbata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nais variabilis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ophidonais serpentina	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paranais frici	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vejdovskyella intermedia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aulodrilus pigueti	18	12	0	0	0	18	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0
Ilyodrilus templetoni	18	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Limnodrilus cervix	3	12	12	0	0	54	0	0	15	0	0	18	0	0	0	0	0	8	0	0	0	0	0
Limnodrilus hoffmeisteri	126	75	30	1170	426	252	216	82	165	78	405	99	873	362	129	126	252	65	510	342	288	24	21
Limnodrilus profundicola	0	12	0	78	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Potamothrix bavaricus	0	0	0	78	3	0	15	16	15	3	0	0	216	0	13	14	0	24	39	0	24	24	0
Potamothrix bedoti	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Potamothrix moldaviensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0
Tubifex tubifex	0	0	3	0	0	0	0	0	0	0	0	0	0	82	0	0	0	0	0	69	48	24	0
Tubificid immature: bifid	198	168	168	702	414	234	135	192	165	60	495	108	120	160	67	182	243	144	234	462	120	120	108
Tubificid immature: hair + pectinate	72	0	12	156	69	54	15	16	30	6	45	0	72	40	27	0	81	40	117	132	72	24	54
Tubificidae (newly hatched)	0	0	0	78	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Lumbricillus	0	0	12	0	0	0	3	16	0	0	0	0	0	0	0	0	0	8	0	66	24	48	
Hydrachnida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Limnesia	0	0	0																				
Neumania	0	0	0																				
Koenikea	0	0	0																				
Unionicola	0	0	0																				
Amphipoda	0	0	0																				
Gammarus	0	0	0																				
Gammarus fasciatus	0	0	0																				
Gammarus pseudolimnaeus	0	0	0																				
Acentria	0	0	0																				
Pericoma	0	0	0																				
Dreissena polymorpha	15	27	15																				
Chironomus sp.	3	0	0																				
Cladopelma (?) sp.																							
Cryptochironomus sp.																							
Cryptotendipes																							
Dicrotendipes sp.																							
Endochironomus sp.																							
Glyptotendipes sp.																							
Parachironomus sp.																							
Polypedilum sp.																							
Pseudochironomus sp.																							
Stictochironomus sp.																							
Unknown Chironomini																							
Cladotanytarsus																							
Tanytarsus sp.																							
Paratanytarsus																							
Cricotopus sp.																							
Psectrocladius																							
Procladius sp																							
Polypedilum																							

Appendix B. Raw data of 2000 OnoAppendix B. Raw data of 2000 Onondaga Lake macroinvertebrate petite ponar samples.

Facility Code	3024	3025	3026	3027	3028	3029	3030	3031	3032	3033	3034	3035	3036	3037	3038	3039	3040	3041	3042	3043	3044	3045	3046
Site number	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2
Replicate #	24	25	26	27	28	29	30	31	32	33	34	35	36	1	2	3	4	5	6	7	8	9	10
Chaetogaster diaphanus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dero digitata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nais bretscheri	0	0	0	0	0	0	0	0	0	0	0	0	0	36	6	30	0	1	0	0	20	48	33
Nais communis/variabilis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Nais elinguis	1215	840	2436	495	648	270	714	564	510	1512	1029	1872	705	0	52	40	28	0	0	196	36	136	7
Nais pardalis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
Nais barbata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nais variabilis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ophidonais serpentina	0	0	0	0	0	0	0	0	0	0	0	0	0	288	3	0	0	1	0	0	0	16	0
Paranais frici	0	21	0	0	0	0	0	0	0	0	0	36	0	0	16	300	205	11	5	154	136	200	67
Vejdovskyella intermedia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	4	0	7
Aulodrilus pigueti	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	80	14	5	0	7	12	0	40
Ilyodrilus templetoni	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Limnodrilus cervix	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Limnodrilus hoffmeisteri	168	126	42	99	180	160	201	294	162	15	30	9	9	48	6	30	105	16	7	10	3	0	48
Limnodrilus profundicola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Potamothrix bavaricus	0	0	0	0	18	0	21	42	0	0	0	0	0	0	0	14	0	1	0	0	4	0	8
Potamothrix bedoti	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0
Potamothrix moldaviensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tubifex tubifex	3	0	3	3	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Tubificid immature: bifid	108	105	210	105	72	70	105	147	90	57	105	180	60	264	4	30	28	6	3	7	0	8	120
Tubificid immature: hair + pectinate	27	0	42	75	108	20	0	84	60	27	21	36	3	0	0	0	0	1	0	0	4	0	27
Tubificidae (newly hatched)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lumbricillus	0	0	0	0	0	0	0	0	0	3	0	36	0	0	0	0	0	0	0	0	0	0	0
Hydrachnida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Limnesia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Neumania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Koenikea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Unionicola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Amphipoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gammarus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	6	2	0	0	5	0	2	0
Gammarus fasciatus	0	0	0	0	0	0	0	0	0	0	0	0	0	45	0	0	0	0	0	0	0	0	0
Gammarus pseudolimnaeus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	2	0	0	1	0	1	0	0
Acentria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pericoma	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0
Dreissena polymorpha	15	6	9	6	9	2	9	6	6	3	9	12	6	3	128	182	73	134	51	109	77	206	27
Chironomus sp.	0	0	0	0	3	0	0	0	0	0	0	0	0	0	2	2	0	1	0	0	1	0	5
Cladopelma (?) sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	0	0	1	0	4
Cryptochironomus sp.	3	0	0	0	0	0	0	0	0	0	0	0	0	6	10	0	2	6	1	2	2	8	1
Cryptotendipes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dicrotendipes sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	1	0	0	0	1
Endochironomus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Glyptotendipes sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Parachironomus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	4	8	1	6	4	6	13
Polypedilum sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pseudochironomus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stictochironomus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unknown Chironomini	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	3	0	2	1	0	0
Cladotanytarsus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	2	0	1	1	2	0
Tanytarsus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Paratanytarsus sp.	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cricotopus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psectrocladius sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Procladius sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polypedilum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix B. Raw data of 2000 Ono:Appendix B. Raw data of 2000 Onondaga Lake macroinvertebrate petite ponar samples

Facility Code	3047	3048	3049	3050	3051	3052	3053	3054	3055	3056	3057	3058	3059	3060	3061	3062	3063	3064	3065	3066	3067	3068	3069
Site number	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Replicate #	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
Chaetogaster diaphanus	0	0	0	Vial broken during transport to lab.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dero digitata	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Nais bretscheri	2	12	90		54	24	8	0	3	6	0	0	30	56	9	36	8	45	0	1	2	9	
Nais communis/variabilis	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Nais elinguis	1	0	9		6	40	24	5	78	12	54	102	18	0	18	12	8	18	0	2	13	6	
Nais pardalis	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Nais barbata	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Nais variabilis	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Ophidonais serpentina	1	0	0		0	8	8	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	
Paranais frici	7	264	225		198	152	168	150	101	222	252	176	108	232	387	150	232	387	0	0	21	5	
Vejdovskyella intermedia	0	0	9		0	0	16	0	0	0	12	0	6	0	0	6	0	0	0	0	0	0	
Aulodrilus pigueti	6	108	90		54	80	56	20	0	30	36	30	60	32	36	36	48	99	0	0	0	0	
Ilyodrilus templetoni	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Limnodrilus cervix	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Limnodrilus hoffmeisteri	9	24	24		12	88	28	35	0	30	8	0	24	30	18	20	8	0	0	0	0	0	
Limnodrilus profundicola	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Potamothrix bavaricus	6	24	9		12	0	40	10	0	0	0	6	22	0	9	2	0	9	0	0	0	0	
Potamothrix bedoti	0	0	0		0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	
Potamothrix moldaviensis	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Tubifex tubifex	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Tubificid immature: bifid	31	240	63		18	64	80	55	0	6	12	0	54	80	36	42	104	36	0	0	0	0	
Tubificid immature: hair + pectinate	3	0	0		0	8	0	5	0	0	0	0	18	0	0	0	0	0	0	0	0	0	
Tubificidae (newly hatched)	1	0	9		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Lumbricillus	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Hydrachnida	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Limnesia	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Neumania	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Koenikea	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	
Unionicola	0	2	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Amphipoda	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Gammarus	0	2	3		0	12	0	0	3	6	2	6	2	0	3	0	0	0	3	1	2	0	
Gammarus fasciatus	0	0	0		0	0	0	0	0	0	0	0	12	0	0	0	0	0	4	0	9	0	
Gammarus pseudolimnaeus	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Acentria	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	
Pericoma	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Dreissena polymorpha	5	96	213		136	148	192	66	107	178	128	190	144	176	306	206	104	165	41	107	54	109	
Chironomus sp.	0	4	0		0	6	2	5	1	0	7	4	0	4	0	2	0	0	1	0	0	2	
Cladopelma (?) sp.	0	4	0		0																		
Cryptochironomus sp.	2	8	6		11																		
Cryptotendipes	0	0	0		0																		
Dicrotendipes sp.	0	0	0		0																		
Endochironomus sp.	0	0	0		0																		
Glyptotendipes sp.	0	0	0		0																		
Parachironomus sp.	1	6	18		11																		
Polypedilum sp.	0	0	0		0																		
Pseudochironomus sp.	0	0	0		0																		
Stictochironomus sp.	0	0	0		0																		
Unknown Chironomini	0	2	0		0																		
Cladotanytarsus sp.	0	0	3		2																		
Tanytarsus sp.	0	0	0		0																		
Paratanytarsus sp.	0	0	0																				
Cricotopus sp.	0	0	0																				
Psectrocladius sp.	0	2	0																				
Procladius sp.	0	0	0																				
Polypedilum	0	0	0																				

Appendix B. Raw data of 2000 OnorAppendix B. Raw data of 2000 Onondaga Lake macroinvertebrate petite ponar samples

Facility Code	3070	3071	3072	3073	3074	3075	3076	3077	3078	3079	3080	3081	3082	3083	3084	3085	3086	3087	3088	3089	3090	3091	3092
Site number	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Replicate #	34	35	36	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Chaetogaster diaphanus	0	0	0	0	0	0	0	0	0	0	0	0	0	40	0	0	0	0	0	0	0	0	0
Dero digitata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
Nais bretscheri	0	0	0	123	328	592	350	312	88	416	324	187	564	640	74	69	81	156	9				
Nais communis/variabilis	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
Nais elinguis	0	45	13	0	0	16	0	0	4	0	0	0	0	0	0	0	0	0	0				
Nais pardalis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
Nais barbata	0	0	0	0	0	0	0	0	0	0	24	0	0	100	0	3	3	4	0				
Nais variabilis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
Ophidonais serpentina	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
Paranais frici	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
Vejdovskyella intermedia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
Aulodrilus pigueti	0	0	0	3	96	160	110	40	56	32	60	53	84	40	16	30	21	20	1				
Ilyodrilus templetoni	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4				
Limnodrilus cervix	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
Limnodrilus hoffmeisteri	0	0	0	3	0	4	0	8	7	0	0	0	0	0	0	0	0	0	2				
Limnodrilus profundicola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
Potamothrix bavaricus	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
Potamothrix bedoti	0	0	0	0	0	8	2	8	16	8	48	0	0	0	4	10	0	0	0				
Potamothrix moldaviensis	0	0	0	3	0	0	0	0	0	0	4	7	0	0	0	0	0	0	0				
Tubifex tubifex	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
Tubificid immature: bifid	0	0	1	33	28	16	10	40	8	8	38	69	60	100	23	42	46	8	1				
Tubificid immature: hair + pectinate	0	0	0	15	32	32	30	16	24	8	96	7	24	60	14	12	21	4	8				
Tubificidae (newly hatched)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
Lumbricillus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
Hydrachnida	0	0	0	0	0	0	0	0	0	12	0	0	0	0	0	0	0	0	0				
Limnesia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
Neumania	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
Koenikea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
Unionicola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
Amphipoda	0	0	0	0	0	0	0	0	0	4	0	1	0	0	1	0	1	0	0				
Gammarus	0	0	0	0	2	0	0	0	0	4	0	0	0	12	0	0	0	5	2				
Gammarus fasciatus	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
Gammarus pseudolimnaeus	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	6	1				
Acentria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0				
Pericoma	0	0	0	0	0	0	0	0	0	0	2	0	8	8	0	0	0	0	0				
Dreissena polymorpha	37	108	109	46	106	152	172	196	76	152	176	156	272	104	86	40	75	71	7				
Chironomus sp.	0	0	0	2	4	12	0	2	3	2	0	1	4	0	2	1	9	0	2				
Cladopelma (?) sp.	0	0	0	2	4	12	0	2	3	2	0	1	0	0	0	1	1	0	2				
Cryptochironomus sp.	0	0	0	0	0	8	0	0	1	2	2	1	0	0	1	0	0	1	0				
Cryptotendipes	0	0	0	0	0	0	0	0															
Dicrotendipes sp.	0	0	0	0	0	0	0	0															
Endochironomus sp.	0	1	0	0	0	0	0	0															
Glyptotendipes sp.	0	0	0	2	0	0	0	0															
Parachironomus sp.	0	0	0	1	4	4	10	2															
Polypedilum sp.	0	0	0	0	0	0	0	0															
Pseudochironomus sp																							
Stictochironomus sp.																							
Unknown Chironomini																							
Cladotanytarsus																							
Tanytarsus sp.																							
Paratanytarsus																							
Cricotopus sp.																							
Psectrocladius																							
Procladius sp.																							
Polypedilum																							

Appendix B. Raw data of 2000 OnorAppendix B. Raw data of 2000 Onondaga Lake macroinvertebrate petite ponar samples.

Facility Code	3093	3094	3095	3096	3097	3098	3099	3100	3101	3102	3103	3104	3105	3106	3107	3108	3109	3110	3111	3112	3113	3114	3115
Site number	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	5	5	5	5	5	5
Replicate #	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	1	2	3	4	5	6	7
Chaetogaster diaphanus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dero digitata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nais bretscheri	78	282	48	42	64	42	312	112	288	48	248	144	96	328	27	233	33	198	28	63	20	88	30
Nais communis/variabilis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nais elinguis	0	6	0	0	2	2	0	5	0	0	0	0	6	16	1	0	67	6	8	3	8	96	16
Nais pardalis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nais barbata	6	0	4	0	0	0	0	0	0	0	8	0	0	0	0	0	47	6	10	3	4	64	4
Nais variabilis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ophidonais serpentina	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paranais frici	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vejdovskyella intermedia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aulodrilus pigueti	48	40	26	46	16	12	40	59	40	24	32	48	15	40	15	40	13	6	4	6	12	24	10
Ilyodrilus templetoni	0	0	0	0	0	2	0	5	0	0	0	6	3	0	0	0	7	0	0	0	0	0	0
Limnodrilus cervix	0	0	0	0	0	0	0	0	0	0	8	0	0	0	1	0	0	0	0	0	0	0	0
Limnodrilus hoffmeisteri	3	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	9	6	2	2	6	8	2
Limnodrilus profundicola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Potamothrix bavaricus	0	0	0	0	0	0	0	16	0	0	0	6	3	0	0	0	7	6	0	0	6	2	6
Potamothrix bedoti	0	0	3	1	0	2	0	5	16	0	0	12	10	8	0	7	60	0	40	21	8	0	12
Potamothrix moldaviensis	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	2	0	1	0	1
Tubifex tubifex	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tubificid immature: bifid	32	36	16	22	24	32	49	28	34	53	72	48	22	24	16	60	27	36	12	39	14	72	34
Tubificid immature: hair + pectinate	6	18	10	8	15	6	24	37	64	24	24	42	24	0	1	13	53	42	28	36	34	80	16
Tubificidae (newly hatched)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lumbricillus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydrachnida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Limnesia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Neumania	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Koenikea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unionicola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Amphipoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gammarus	0	0	1	0	2	0	1	4	6	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Gammarus fasciatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gammarus pseudolimnaeus	1	0	0	0	1	0	0	0	0	0	4	1	0	0	0	0	0	0	2	0	0	0	0
Acentria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paricoma	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dreissena polymorpha	33	90	25	28	25	16	86	39	104	32	92	53	31	80	22	127	11	32	30	24	15	48	21
Chironomus sp.	3	4	6	0	2	1	6	4	4	5	4	0	2	0	6	1	3	6	1	10	10	10	8
Cladopelma (?) sp.	3	4	6	0	2	1	6	4	2	5	4	0	2	0	6	1	3	6	1	10	10	10	8
Cryptochironomus sp.	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	8	3	10	3
Cryptotendipes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dicrotendipes sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	1	0	0	0	0
Endochironomus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Glyptotendipes sp.	1	0	0	0	0	0	0	0	0	1	2	1	0	0	0	0	0	1	1	0	0	0	1
Parachironomus sp.	6	10	8	6	9	10	14	15	10	11	14	2	10	14	6	8	1	12	5	16	7	14	9
Polypedilum sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pseudochironomus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stictochironomus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unknown Chironomini	1	4	0	1	1	0	3	0	6	4	0	1	2	2	0	3	3	11	2	3	2	4	3
Cladotanytarsus sp.	4	10	3	2	2	2	2	1	8	6	10	6	1	2	1	4	1	0	0	1	0	0	0
Tanytarsus sp.	1	0	5	0	0	0	0	0	8	0	2	1	0	0	0	0	0	0	0	0	0	0	0
Paratanytarsus sp.	0	0	2	0	2	0	1	0	0	0	2	0	0	0	0	0	0	0	1	0	0	2	1
Cricotopus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psectrocladius sp.	1	6	1	0	2	1	3	0	4	5	2	5	0	2	1	4	0	1	0	2	1	4	0
Procladius sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polypedilum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix B. Raw data of 2000 OnoiAppendix B. Raw data of 2000 Onondaga Lake macroinvertebrate petite ponar samples.

Facility Code	3116	3117	3118	3119	3120	3121	3122	3123	3124	3125	3126	3127	3128	3129	3130	3131	3132	3133	3134	3135	3136	3137	3138
Site number	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Replicate #	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Chaetogaster diaphanus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dero digitata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	3	0	0	0	0
Nais bretscheri	44	18	33	4	22	48	92	27	14	20	36	9	68	24	36	27	91	48	27	28	34	176	18
Nais communis/variabilis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
Nais elinguis	24	8	6	2	4	21	16	15	6	2	15	5	12	10	20	9	16	21	24	10	8	16	24
Nais pardalis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nais barbata	0	22	3	0	4	3	0	0	1	0	3	1	0	0	48	9	5	27	3	10	4	16	21
Nais variabilis	0	0	0	0	0	0	0	0	0	0	0	0	4	0	8	3	0	0	0	0	0	0	0
Ophidonais serpentina	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paranais frici	0	0	0	0	0	0	4	0	0	0	0	0	0	2	0	0	0	0	3	2	2	0	0
Vejdovskyella intermedia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aulodrilus pigueti	16	2	9	6	6	15	12	9	7	4	39	6	24	12	28	12	11	32	18	10	14	0	9
Ilyodrilus templetoni	0	0	0	0	0	0	4	0	1	0	0	0	4	0	4	0	0	0	0	0	0	0	0
Limnodrilus cervix	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Limnodrilus hoffmeisteri	5	2	6	2	2	8	8	30	4	6	5	0	4	4	4	7	5	1	0	4	2	0	6
Limnodrilus profundicola	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Potamothrix bavaricus	1	0	7	0	0	0	0	6	1	4	6	2	2	0	0	9	7	5	3	4	3	24	0
Potamothrix bedoti	32	4	54	6	8	6	24	27	2	14	3	1	4	8	8	6	0	21	18	12	6	16	24
Potamothrix moldaviensis	0	0	3	0	2	0	4	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0
Tubifex tubifex	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tubificid immature: bifid	28	32	15	13	20	18	24	30	9	18	24	6	32	10	28	33	43	53	42	10	22	80	15
Tubificid immature: hair + pectinate	64	8	33	19	42	54	20	3	20	48	21	9	52	34	40	27	85	48	27	32	24	96	27
Tubificidae (newly hatched)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lumbricillus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydrachnida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Limnesia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Neumania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Koenikea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unionicola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Amphipoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gammarus	0	0	0	1	0	1	0	0	0	0	1	0	0	0	3	0	0	0	0	1	0	0	0
Gammarus fasciatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gammarus pseudolimnaeus	0	0	0	0	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0
Acentria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pericoma	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Dreissena polymorpha	11	21	23	31	30	41	52	25	21	2	23	92	99	47	81	120	75	61	49	99	26	204	19
Chironomus sp.	1	5	2	6	3	7	3	7	6	5	9	8	3	2	3	6	3	4	4	2	5	10	2
Cladopelma (?) sp.	1	5	2	6	3	7	3	7	6	5	9	8	3	2	3	6	3	4	4	2	5	10	2
Cryptochironomus sp.	1	7	2	1	0	6	7	1	1	0	1	2	2	0	29	0	4	3	2	1	0	4	1
Cryptotendipes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dicrotendipes sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Endochironomus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glyptotendipes sp.	0	3	0	0	0	0	0	2	0	0	0	2	0	0	3	0	1	0	0	0	0	0	3
Parachironomus sp.	5	10	3	0	6	4	8	10	2	8	6	9	8	5	15	5	5	7	5	8	10	6	7
Polypedilum sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pseudochironomus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stictochironomus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unknown Chironomini	1	1	4	1	1	3	6	1	0	5	7	0	6	5	12	5	4	5	1	3	1	10	1
Cladotanytarsus sp.	0	3	0	0	0	4	1	2	0	0	0	0	4	3	3	4	3	0	0	2	2	2	0
Tanytarsus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paratanytarsus sp.	0	4	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0
Cricotopus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psectrocladius sp.	0	2	1	1	0	0	0	1	0	0	1	2	1	0	0	0	1	0	2	0	0	4	0
Procladius sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polypedilum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix B. Raw data of 2000 Ono Appendix B. Raw data of 2000 Onondaga Lake macroinvertebrate petite ponar samples.

Facility Code	3139	3140	3141	3142	3143	3144	3145	3146	3147														
Site number	5	5	5	5	5	5	4	4	4	-	-	-											
Replicate #	31	32	33	34	35	36	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Chaetogaster diaphanus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0
Dero digitata	0	0	0	0	0	0	0	2	0	0	0	0	0	0	6	0	0	0	0	7	7	10	
Nais bretscheri	2	0	8	2	36	10	0	6	18	9	5	20	1	0	30	0	4	0	16	7	7	20	
Nais communis/variabilis	0	0	0	2	0	0	0	0	0	0	10	0	5	0	12	0	0	0	2	0	7	0	
Nais elinguis	4	3	12	2	8	4	0	4	6	12	20	30	1	20	48	20	0	0	8	27	47	30	
Nais pardalis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Nais barbata	1	0	4	2	0	0	0	0	0	0	0	0	3	0	0	0	0	0	2	0	0	20	
Nais variabilis	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Ophidonais serpentina	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	5	0	7	0	0	
Paranais frici	0	0	4	0	3	0	0	2	0	0	0	0	0	0	0	4	0	0	0	7	0	0	
Vejdovskyella intermedia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Aulodrilus pigueti	7	12	12	0	3	0	10	4	18	3	25	32	4	20	24	24	8	20	16	33	40	20	
Ilyodrilus templetoni	0	3	4	0	0	0	0	0	0	0	0	0	0	5	0	8	4	5	2	0	0	0	
Limnodrilus cervix	0	0	0	0	0	0	10	0	0	3	10	0	0	0	6	8	8	0	1	13	0	0	
Limnodrilus hoffmeisteri	4	3	9	0	3	0	10	3	54	3	6	20	1	20	13	16	16	10	2	13	28	24	
Limnodrilus profundicola	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Potamothrix bavaricus	1	0	21	14	12	20	0	2	12	0	10	10	0	10	0	20	4	0	2	0	0	10	
Potamothrix bedoti	4	60	20	32	18	22	15	8	6	0	30	0	2	30	18	16	8	75	12	7	15	60	
Potamothrix moldaviensis	0	4	4	0	12	2	10	0	6	0	0	0	0	5	0	0	0	9	0				
Tubifex tubifex	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	4	5	0				
Tubificid immature: bifid	7	18	36	6	24	18	80	52	72	60	95	150	27	50	72	28	64	40	42				
Tubificid immature: hair + pectinate	6	54	52	44	33	20	115	34	90	51	42	230	20	90	66	84	92	85	24				
Tubificidae (newly hatched)	0	0	0	0	0	0	0	0	0	0	0	0	0										
Lumbricillus		-	-	-	-	0	0	0	0	0	0												
Hydrachnida																							
imnesia																							
Neumania																							
Koenikea																							
Unionicola																							
Amphipoda																							
Gammarus																							
Gammarus fasciatus																							
Gammarus pseudolimnaeus																							
Acentria																							
Pericoma																							
Dreissena polymorpha																							
Chironomus sp.																							
Cladopelma (?) sp.																							
Cryptochironomus sp.																							
Cryptotendipes																							
Dicrotendipes sp.																							
Endochironomus sp.																							
Glyptotendipes sp.																							
Parachironomus sp.																							
Polypedilum sp.																							
Pseudochironomus sp																							
Stictochironomus sp.																							
Unknown Chironomini																							
Cladotanytarsus																							
Tanytarsus sp.																							
Paratanytarsus																							
Cricotopus sp.																							
Psectrocladius																							
Procladius sp																							
Polypedilum																							

Appendix B. Raw data of 2000 OnorAppendix B. Raw data of 2000 Onondaga Lake macroinvertebrate petite ponar samples.

Facility Code	3162	3163	3164	3165	3166	3167	3168	3169	3170										
Site number	4	4	4	4	4	4	4	4	4										
Replicate #	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
Chaetogaster diaphanus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dero digitata	12	4	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nais bretscheri	0	2	18	8	1	7	16	0	6	2	4	20	12	2	8	7	8	10	8
Nais communis/variabilis	0	0	4	0	0	20	8	0	0	0	8	0	6	0	0	5	8	8	4
Nais elinguis	12	16	14	28	9	40	12	36	36	10	32	45	15	8	40	7	20	22	2
Nais pardalis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nais barbata	0	0	2	0	5	7	0	0	0	2	4	0	0	0	12	2	0	8	4
Nais variabilis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0
Ophidonais serpentina	0	8	0	0	5	0	0	20	12	2	8	10	0	2	8	3	0	6	0
Paranais frici	0	0	0	4	0	0	0	4	0	0	0	0	0	0	0	0	4	0	0
Vejdovskyella intermedia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aulodrilus pigueti	48	0	0	0	1	0	0	4	0	2	8	0	0	0	8	0	4	0	4
Ilyodrilus templetoni	0	0	0	0	1	0	0	0	0	0	0	0	6	0	0	0	0	0	0
Limnodrilus cervix	1	0	0	0	0	0	4	5	1	0	0	0	0	1	0	0	0	0	0
Limnodrilus hoffmeisteri	1	2	2	13	2	7	8	0	0	0	6	1	3	1	0	0	4	0	0
Limnodrilus profundicola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Potamothrix bavaricus	1	1	0	0	0	8	0	0	6	2	1	0	0	0	8	0	0	0	1
Potamothrix bedoti	24	0	8	8	4	20	20	0	6	2	12	15	6	3	0	3	4	8	1
Potamothrix moldaviensis	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	4	0	4
Tubifex tubifex	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0
Tubificid immature: bifid	72	54	60	92	43	140	80	100	168	60	108	85	69	40	72	35	88	36	8
Tubificid immature: hair + pectinate	126	10	8	68	18	113	48	28	78	14	24	60	69	15	72	8	48	18	8
Tubificidae (newly hatched)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lumbricillus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydrachnida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Limnesia	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Neumania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Koenikea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unionicola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Amphipoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gammarus	0	0	0	0	2	0	0	0	0	0	0	0	0	2	0	0	0	0	0
Gammarus fasciatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gammarus pseudolimnaeus	0	1	4	5	0	1	0	0	1	0	2	2	2	0	5	0	1	0	1
Acentria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pericoma	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dreissena polymorpha	2	3	7	6	10	4	6	10	6	2	5	11	4	4	6	2	6	2	9
Chironomus sp.	1	0	0	1	0	0	0	0	1	0	0	0	3	0	1	0	0	0	0
Cladopelma (?) sp.	1	0	0	1	0	0	0	0	1	0	0	0	3	0	1	0	0	0	0
Cryptochironomus sp.	5	1	2	5	3	5	0	2	2	0	3	7	4	3	6	0	5	0	7
Cryptotendipes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dicrotendipes sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Endochironomus sp.	0	1	2	0	1	3	2	1	1	2	0	1	1	0	0	1	2	2	0
Glyptotendipes sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Parachironomus sp.	2	0	0	0	0	1	0	0	1	0	1	0	0	1	0	0	0	1	0
Polypedilum sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pseudochironomus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stictochironomus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unknown Chironomini	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Cladotanytarsus sp.	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Tanytarsus sp.	0																		
Paratanytarsus sp.	0																		
Cricotopus sp.	0																		
Psectrocladius sp.	2																		
Procladius sp.	0																		
Polypedilum																			

Appendix C

Lake Macroinvertebrate Multiplate Data

Appendix C. Raw data of 2000 Onondaga Lake macroinvertebrate multiplate samples.

Entire Sample / **Taxa**	**Facility code** 3181	**3182**	**3183**	**3184**	**3185**	**3186**
Chaetogaster diaphanus	56	24	0	20	0	180
Nais bretschei	532	208	708	256	248	360
Nais simplex	84	100	196	216	36	60
Ophidonais serpentina	448	172	204	68	120	1256
Stylaria lacustris	504	308	884	668	576	720
Vejdovskyella intermedia	28	0	24	0	0	180
Aulodrilus pigueti	0	0	0	0	0	60
Limnodrilus profundicola	0	0	0	0	12	0
Potamothrix bavaricus	0	0	0	0	12	0
Tubificid immature: bifid chaetae	0	0	0	0	24	180
Hydrachnida	0	0	0	0	0	12
Limnesia	4	0	0	0	0	20
Amphipoda	0	0	4	0	0	0
Gammaridae	0	0	0	0	8	48
Gammarus fasciatus	0	0	0	0	0	4
Gammarus pseudolimnaeus	40	28	12	24	52	56
Podocopida	0	0	0	0	0	4
Caecidotea	0	0	4	0	0	0
Baetidae	4	0	0	0	0	0
Hydroptilidae	4	0	0	0	0	28
Chironomidae pupae	24	16	20	4	4	36
Ablabesmyia mallochi	0	0	0	0	0	48
Chironomus	20	20	0	0	0	0
Cladotanytarsus	120	80	120	32	0	336
Corynoneura	0	20	0	0	0	0
Cricotopus (Isocladius) cf. *intersectus*	120	260	192	96	20	96
Cricotopus (Isocladius) sylvestris grp.	460	300	864	448	640	624
Cricotopus trifascia	0	0	0	0	0	48
Cricotopus (Isocladius)	40	0	0	48	0	0
Cricotopus/Orthocladius	144	0	96	32	60	0
Dicrotendipes modestus	200	80	124	48	80	336
Dicrotendipes neomodestus	0	160	72	4	20	48
Dicrotendipes nervosus	20	0	0	0	0	96
Endochironomus	0	40	4	32	40	144
Glyptotendipes	960	932	1016	804	1168	2872
Nanocladius cf. *rectinervis*	0	0	24	0	0	0
Parachironomus cf. *monochromus*	20	0	48	0	0	0
Procladius (Holotanypus)	0	20	0	0	0	0
Tanytarsus	0	20	0	0	0	0
Dreissena polypmorpha	704	2380	2568	1460	560	2944
Physa	4	0	0	0	0	4

Appendix D

Tributary Kick Sample Macroinvertebrate Data

Appendix D. Raw data of 2000 Onondaga Lake Tributary macroinvertebrate kick and jab samples.

Facility code	3187	3188	3189	3190	3191	3192	3193	3194	3195	3196	3197	3198	3199	3200	3201	3202	3203	3204	3205	3206	3207	3208	3209	3210	3211	3212	3213	3214	3215	3216	3217	3218	3219	3220	3221	3222	3223	3224	3225	3226
Trib	OC	OC	OC	OC	OC	OC	OC	OC	OC	OC	OC	OC	OC	OC	OC	OC	LC	LC	LC	LC	LC	LC	LC	LC	LC	LC	LC	LC	HB	HB	HB	HB	HB	HB	HB	HB	HB	HB	HB	HB
Site	1	1	1	1	2	2	2	2	3	3	3	3	4	4	4	4	1	1	1	1	2	2	2	2	3	3	3	3	1	1	1	1	2	2	2	2	3	3	3	3
Replicate	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Dugesia tigrina	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	1	0	0	0	0	0	0	0	0	0	0	3	0
Enchytraeus	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lumbricillus	0	0		3	0	0	0	0	1	0	0	0	0	1	7	0	3	29	7	15	0	1	6	2	13	3	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Lumbriculidae	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dero digitata	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	0	2
Nais elinguis	0	0		0	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	3	0	0	0	0	0	0	0	0	0	0	2	1
Ophidonais **serpentina**	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	3	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aulodrilus **pigueti**	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Ilyodrilus **templetoni**	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0
Limnodrilus cervix	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	12	5	1	1	2	3	1	0
Limnodrilus claparedeianus	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	3	1	0	0	0	0
Limnodrilus hoffmeisteri	0	0		0	0	1	0	0	0	0	2	0	5	2	0	0	2	2	1	1	1	6	3	13	6	18	1	12	5	14	38	26	42	23	18	16	8	6	3	0
Limnodrilus profundicola	0	0		0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0
Limnodrilus udekemianus	0	0		0	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	1	0	0	0	2	0	0	1	3	8	3	6	1	0	0	0	0
Potamothrix bedoti	0	0		0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Potamothrix bavaricus	0	0		0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0
Potamothrix moldaviensis	0	0		0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	4	2	0	0	0	0	0	0	0	0
Quistadrilus multisetosus	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Tubifex tubifex	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	3	0	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Tubificid immature: **bifids**	0	0		0	18	25	14	14	4	0	1	2	4	46	1	7	23	19	12	7	21	20	33	5	12	51	3	49	62	43	12	45	33	61	48	64	64	32	66	35
Tubificid immature: **b+p**	0	0		0	1	0	1	2	0	0	0	0	4	4	1	0	0	8	3	2	7	10	6	9	4	2	2	5	1	0	0	0	1	1	2	0	3	0	2	1
Lumbricidae	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Allolobophora **chlorotica**	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eiseniella tetraedra	0	1		1	0	0	1	3	0	0	0	0	0	1	0	0	5	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helobdella stagnalis	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mooreobdella fervida	0	0		0	0	0	0	0	0	0	0	0	18	20	24	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mooreobdella	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	7	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hygrobates	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Torrenticola	0	0		0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crangonyx pseudogracilis	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gammarus fasciatus	0	0		0	0	0	0	0	2	0	1	0	0	0	0	0	7	5	9	9	7	10	6	6	0	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0
Gammarus pseudolimnaeus	5	0		2	1	0	1	1	8	18	2	3	0	0	0	0	35	18	43	47	9	14	12	13	1	0	0	0	4	3	4	14	0	0	0	0	3	3	2	13
Gammarus immature/damaged	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0
Caecidotea immature/female)	0	0		0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	1	0	0	4	12	8	7	2	6	2	0	0	0	0	0	0	0	0	0	1	0	2
Caecidotea racovitzai	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	4	3	3	1	1	3	0	0	0	0	0	0	0	0	0	0	0	1	1
Baetis	26	53		34	8	0	13	12	3	1	3	4	0	0	0	0	8	6	2	1	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0
Procloeon	3	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Epeorus	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heptagenia	3	1		4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paraleptophlebia	1	1		5	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tricorythodes	0	0		0	0	1	1	0	1	5	12	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Boyeria	0	0		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coenagrionidae immature	0	0								0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Lanthus parvulus	0	0								0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Perlodidae	0	0								0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acroneuria	2	0								0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agnetina	7	9								0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leuctra	1	1								0	0	0				0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pteronarcys	4	2								0	0	0				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sweltsa	5	0								0	0	0				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nigronia	0	0								0	0	1				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sialis	0	0								0	1	0				0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glossosoma	2	0								0	0	0				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydropsychidae **pupae**	0	0								0	0	0				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cheumatopsyche	0	0								1	3	1				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydropsyche **(early instar)**	1	4								1	0	0				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydropsyche **betteni**	0	0								2	0	0				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydropsyche **bronta**	0	0								25	26	35				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydropsyche **slossonae**	1	0								0	1	0				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydropsyche **sparna**	0	1								2	2	12				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydroptila	0	0								0	0	0				0	0	0	0	0	2	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Oecetis (Pseudosetodes) **avara gp.**	0	0														0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dolophilodes	1	0														0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dubiraphia	0	0														0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Optioservus	1	2														1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Promoresia	0	0														0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stenelmis	0	0														1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Atherix	0	0																							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix D. Raw data of 2000 Onondaga Lake Tributary macroinvertebrate kick and jab samples.

Facility code	3187	3188	3189	3190	3191	3192	3193	3194	3195	3196	3197	3198	3199	3200	3201	3202	3203	3204	3205	3206
Trib	OC	OC	OC	OC	OC	OC	OC	OC	OC	OC	OC	OC	OC	OC	OC	OC	LC	LC	LC	LC
Site	1	1	1	1	2	2	2	2	3	3	3	3	4	4	4	4	1	1	1	1
Replicate	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Chironomidae pupae	0	0	0	0	3	3	0	5	0	4	2	0	0	0	0	0	0	0	0	0
Larsia	0	0	0	1	0	2	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Natarsia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Procladius (Holotanypus)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Thienemannimyia grp.	15	4	8	7	0	3	2	3	8	5	1	1	0	0	0	0	1	1	1	2
Diamesa	0	0	0	0	2	1	2	4	0	0	0	0	0	0	0	0	3	0	1	0
Pagastia	0	0	0	0	0	0	1	0	0	5	2	1	1	7	3	28	0	0	0	4
Prodiamesa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	4	10	6
Brillia flavifrons	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cricotopus bicinctus	0	0	0	1	1	4	4	2	10	6	0	2	0	0	0	0	0	0	0	0
Cricotopus sylvestris grp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cricotopus triannulatus	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cricotopus trifascia	0	0	0	0	3	0	1	1	3	0	0	3	0	0	0	0	0	0	0	0
Cricotopus/Orthocladius	4	0	1	0	4	1	1	1	0	1	1	0	0	0	0	0	1	0	0	0
Cricotopus (Isocladius)	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Eukiefferiella brehmi grp.	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eukiefferiella claripennis grp.	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Eukiefferiella devonica grp.	0	0	0	0	1	0	1	1	1	0	3	1	0	0	0	0	0	0	0	0
Eukiefferiella (early instar)	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psectrocladius	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rheocricotopus	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Thienemanniella cf. *xena*	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Tvetenia bavarica grp.	0	0	0	0	2	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0
Tvetenia discoloripes grp.	0	0	0	0	0	0	0	0	3	4	7	1	0	1	0	0	0	0	0	0
Chironomus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2
Cladopelma	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cryptochironomus	0	0	0	0	1	4	0	1	1	1	0	0	0	0	1	0	2	0	1	0
Cryptotendipes	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dicrotendipes modestus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Microtendipes pedellus grp.	0	0	0	0	3	7	1	2	6	4	3	3	0	0	0	0	0	0	0	0
Phaenopsectra obediens grp.	0	0	0	0	0	0	0	0	1	5	0	3	0	0	0	1	0	0	0	0
Polypedilum aviceps	3	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polypedilum fallax	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polypedilum halterale grp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polypedilum illinoense grp.	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Polypedilum laetum	0	0	1	1	1	1	1	2	9	3	1	2	0	0	0	0	0	0	0	0
Polypedilum scalaenum grp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stictochironomus	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Cladotanytarsus	0	0	0	0	20	23	0	1	1	0	0	0	0	0	0	0	0	0	0	0
Micropsectra	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rheotanytarsus	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stempellinella	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tanytarsus	4	10	4	6	1	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chelifera	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Hemerodromia	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0
Muscidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
Psychodidae pupae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pericoma	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psychoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Simulium	0	1	0	0	2	4	4	0	2	1	1	1	0	0	0	0	2	1	0	0
Chrysops	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Antocha	0	0	0	0	1	0	3	0	3	2	2	2	0	0	0	0	1	0	0	0
Dicranota	0	0	0	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Hexatoma	7	5	5	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tipula	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Musculium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pisidium casertanum	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Pisidium compressum	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Pisidium dubium	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Fossaria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Physa cf. *heterostropha*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Facility code	3207	3208	3209	3210	3211	3212	3213	3214	3215	3216	3217	3218	3219	3220	3221	3222	3223	3224	3225	3226
Trib	LC	LC	LC	LC	LC	LC	LC	LC	HB	HB	HB	HB	HB	HB	HB	HB	HB	HB	HB	HB
Site	2	2	2	2	3	3	3	3	1	1	1	1	2	2	2	2	3	3	3	3
Replicate	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Chironomidae pupae	0	1	3	0	6	0	1	0	2	2	7	0	0	0	1	0	1	7	1	1
Larsia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Natarsia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Procladius (Holotanypus)	0	0	0	0	0	0	0	0	0	9	2	0	3	6	11	8	3	14	5	8
Thienemannimyia grp.	3	5	7	3	2	0	1	0	2	2	1	1	0	0	1	0	0	0	0	0
Diamesa	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pagastia	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Prodiamesa	3	2	1	1	2	2	4	3	0	0	0	0	0	0	0	0	0	0	0	0
Brillia flavifrons	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cricotopus bicinctus	2	0	3	0	1	4	0	0	4	1	1	0	0	0	0	0	1	0	1	0
Cricotopus sylvestris grp.	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	1	1	1	0
Cricotopus triannulatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cricotopus trifascia	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cricotopus/Orthocladius	3	0	1	1	3	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0
Cricotopus (Isocladius)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eukiefferiella brehmi grp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eukiefferiella claripennis grp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eukiefferiella devonica grp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eukiefferiella (early instar)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psectrocladius	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Rheocricotopus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Thienemanniella cf. *xena*	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Tvetenia bavarica grp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tvetenia discoloripes grp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chironomus	10	8	8	25	7	12	4	7	1	13	3	0	0	0	0	0	7	10	7	27
Cladopelma	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Cryptochironomus	0	0	2	0	1	0	0	0	10	1	12	4	0	0	0	0	0	0	0	1
Cryptotendipes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dicrotendipes modestus	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	3	2	2
Microtendipes pedellus grp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phaenopsectra obediens grp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polypedilum aviceps	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polypedilum fallax	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polypedilum halterale grp.	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Polypedilum illinoense grp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polypedilum laetum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polypedilum scalaenum grp.	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0
Stictochironomus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cladotanytarsus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Micropsectra	0	0	0	0	0	1	2	0	1	0	0	0	0	0	0	0	0	0	0	0
Rheotanytarsus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stempellinella	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tanytarsus	0	0	2	1	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0
Chelifera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hemerodromia	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Muscidae	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psychodidae pupae	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Pericoma	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psychoda	0	0	0	0	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Simulium	0	0	0	2	0	0	0	0	1	2	4	3	0	0	0	0	0	0	0	0
Chrysops	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Antocha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dicranota	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hexatoma	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tipula	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Musculium	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Pisidium casertanum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pisidium compressum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pisidium dubium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fossaria	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Physa cf. *heterostropha*	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0